MACHINERY

Design—Construction—Operation

Volume 40 **JULY, 1934** **Number 11**

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MACHINERY

Volume 40 NEW YORK, JULY, 1934 Number 11

Sound Engineering Balances Cost With Expected Results

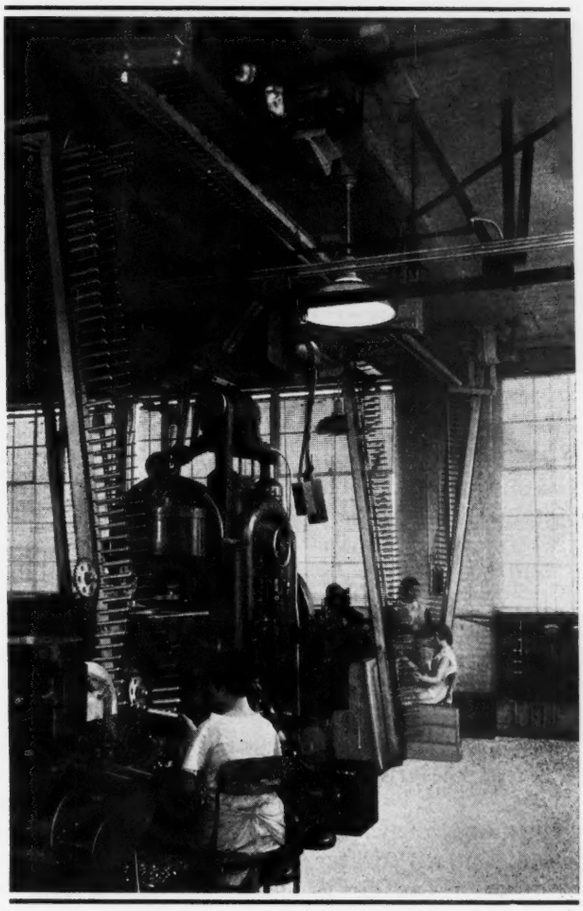
By JOHN H. FRIDEN
Vice-President, The Sun Tube Corporation, Hillside, N. J.

In One Industrial Plant, Vast Changes were Made in Manufacturing Methods and Working Conditions after a Careful Analysis of the Anticipated Advantages

WHEN the engineer sets out to improve manufacturing methods in an industrial plant, he should carefully compare the anticipated results with the amount of money that will have to be spent before he proceeds. It will frequently be found that up to a certain point, outlay of capital for developing new methods will pay handsomely in the way of a better product, lower manufacturing costs, and improved working conditions, but that beyond that point, the spending of a large sum will bring only negligible returns.

Attempts should not be made to obtain absolute perfection to the last detail in manufacturing and work-handling methods. That aim has only too often been the bugaboo of efficiency engineers. The engineer worth his salt should be able to determine approximately where practicality and theory part.

Several years ago, the Sun Tube Corporation, manufacturer of collapsible tubes for tooth paste, shaving cream, and similar products, carefully analyzed its methods with a view to increasing the efficiency of the plant. Before any plans were definitely carried out, it was determined that a reduction of 50 per cent in the manufacturing costs of collapsible tubes would be feasible with an expenditure of about $250,000, but that an additional saving of a few per cent would involve the expenditure of many times the present investment. Obviously, here was the point to draw the line.



The engineers of this plant realized that, in planning a modern industrial plant, the first step is to select or develop machinery that will turn out a product of the desired quality at the highest practical rate of production. Here usually lies the greatest opportunity for cutting costs. Also, the handling of raw materials, partially processed work, and finished products must be so arranged as to minimize trucking,

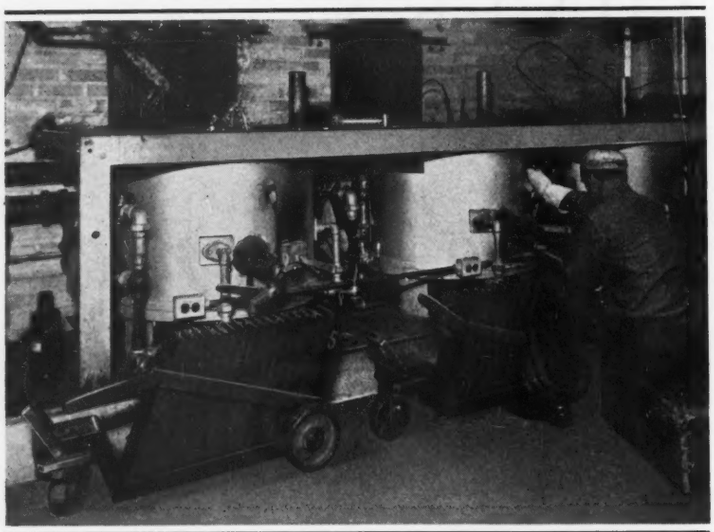


Fig. 1. (Left) Where the Heavy Pigs of Tin are Melted and Recast into Thin Slabs. The Molten Tin Runs Directly into Molds Held on Trucks as Shown

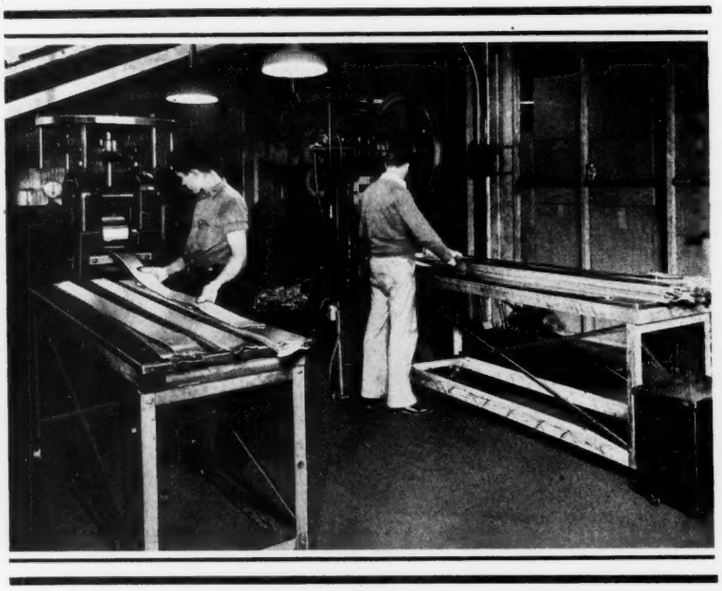


Fig. 2. (Right) The Slabs are Rolled into Long Strips in the Machine at the Left and Slugs are Punched from the Strips in the Machine at the Right

storage, and heavy manual labor. All equipment should be driven by power-saving means.

Often sufficient attention is not paid to providing the best working conditions for the factory employes. Departments should be adequately lighted day and night, floors and machines should be kept clean, a comfortable temperature should be maintained summer and winter, and sanitary rules should be strictly enforced. A factory that provides these facilities will experience little difficulty in keeping employes of higher than average grade, and employes working in the right kind of environment will do their work more efficiently. Some of the methods adopted and equipment installed to meet these aims in the plant referred to are described in the following.

An air conditioning system constantly draws air from outside and thoroughly cleanses it with water pumped from a well 250 feet deep. Clean air is supplied at the rate of 40,000 cubic feet a minute. In winter, the air is heated to give a room temperature of about 70 degrees F., while in summer, the air is cooled to a temperature from 10 to 15 degrees below that prevailing outdoors.

What a contrast with the old plant, in which the room temperature often ran up to 110 degrees F., due to the proximity of ovens used for drying the paint on the tubes. Girls commonly fainted in that atmosphere. The ovens for drying the tubes are now located directly above the tube-making machines, and they are well insulated to prevent discomfort in the working departments. In this clean atmosphere, dust or lint does not get on the wet painted tubes as they pass to the baking ovens.

All walls and ceilings are painted with aluminum to obtain maximum light. The many windows are equipped with wood-strip shades to eliminate the glare of the sun. Blue "Daylight" electric lamp bulbs provide almost day-time conditions for the night shift.

Hand Labor has been Eliminated as Far as Practicable

Collapsible tubes are produced from pure tin which arrives from the Straits Settlements in pigs weighing from 100 to 110 pounds apiece. These pigs reach the plant on motor trucks and are stored in a vault adjacent to the door of delivery. The distance from the truck to the vault door is a matter of only 18 feet, but a portable conveyor is set up to carry the pigs across this space. They are stacked in the vault by hand.

The first step in the manufacturing process is to melt the tin and recast it into thin slabs suitable for rolling. The melting room is directly opposite a corridor from the vault, so that the pigs are trucked less than 30 feet. For the slab-casting process, fifteen molds are mounted on trucks of the type seen in Fig. 1. Large casters facilitate pulling the trucks to and from the melting furnaces, while swinging links and a cam lock make it easy to secure the molds for the casting operation and to release them afterward. Fumes from the melting process are carried away by the ventilating system.

Immediately outside the melting room are the machines shown in Fig. 2. The machine on the left reduces the thickness of the slabs and increases their length as they pass between two rolls, until long strips are obtained. The slabs are handled in quantities of about seventy-five. After each pass, the rolls are adjusted to reduce the thickness of the strip still more. Each slab is run through the rolls about five times, the rolling always being done from the right side of the machine to the left.

A table of the type seen in the foreground is used on each side of the rolling machine. These tables are equipped with ball-bearing casters, so that they can be easily pushed from one side of the machine to the other. Also, when the strips have been reduced to the desired thickness, the loaded table is

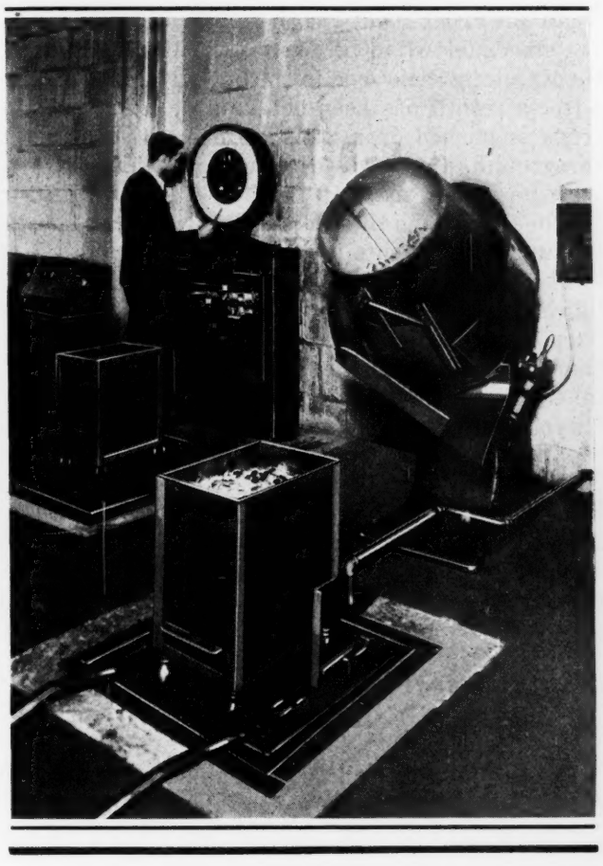


Fig. 3. (Left) Slugs in Quantities up to about 500 Pounds are Conveniently Handled in Box Type Trucks with Ball-bearing Casters

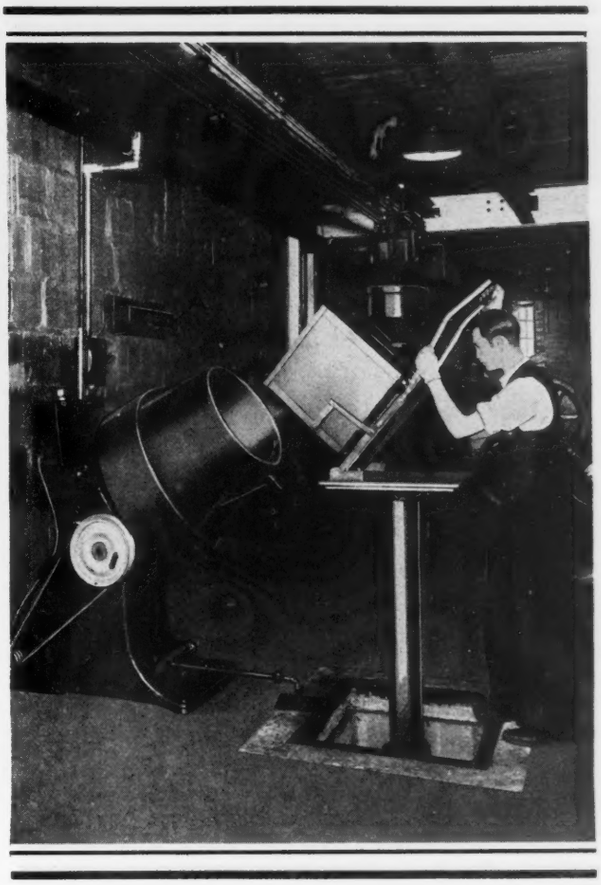


Fig. 4. (Right) An Air-operated Elevator Lifts the Trucks of Slugs to a Convenient Height for Dumping into a Tumbling Barrel

Fig. 5. A Monorail Hoist Delivers the Slugs Automatically from Storage Bins to the Tube-extruding Machines as Required

quickly transferred to the other machine shown in Fig. 2, where slugs are punched from the strips. Transfer of the table with its load has saved a previous strip-handling operation.

The press blanks the slugs to various diameters, depending upon the diameter of the collapsible tubes to be produced from them. The slugs fall directly into box-like trucks of the type seen in Fig. 3, while the scrap is piled on a large platform truck and returned to the melting room.

Heavy Truck Loads of Slugs are Handled with Ease

Five hundred pounds is the average weight of a small box truck loaded with slugs, but ball-bearing casters enable it to be pushed with little effort to the weighing scale seen in the background of Fig. 3. After a record has been obtained of each load, the truck is pushed on a lift platform, as seen in the foreground. Compressed air elevates this platform with its loaded truck to the height seen in Fig. 4. The operator then tilts the truck forward, as shown, to empty its contents into a tumbling barrel.

The tumbling operation spreads a thin film of lubricant over all the slugs and removes a slight burr left from blanking. When the slugs have been tumbled the required length of time, they are permitted to slide down a chute that surrounds the barrel and into a bucket attached to the one-half ton Monorail hoist seen in the background of Fig. 4. They are then carried several feet and emptied into bins, such as seen in Fig. 5, where they are stored as much as one day ahead to meet the requirements of the tube-extruding machines. Forward, reverse, raise, lower, and stop buttons on a pendent switch give a convenient control of the hoist.

Little Manual Effort Required in Supplying Tons of Slugs to the Machines

In the tube-extruding department, one of the duties of the foreman is to see that all nine extruding machines are kept supplied with slugs. When the hopper of any machine runs low, the foreman merely presses an electric button at that machine. This causes an indicator to drop on board *A*, Fig. 4. There is a separate indicator for each machine, so

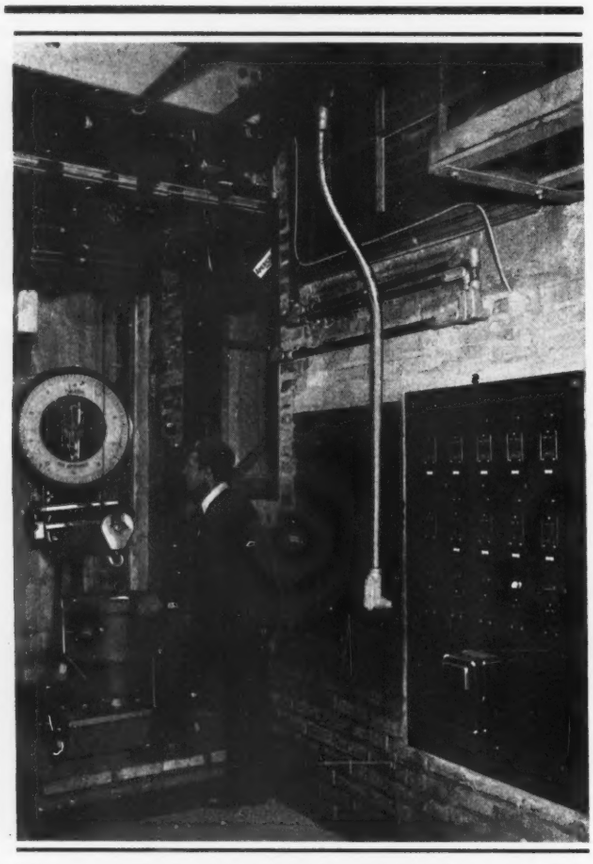
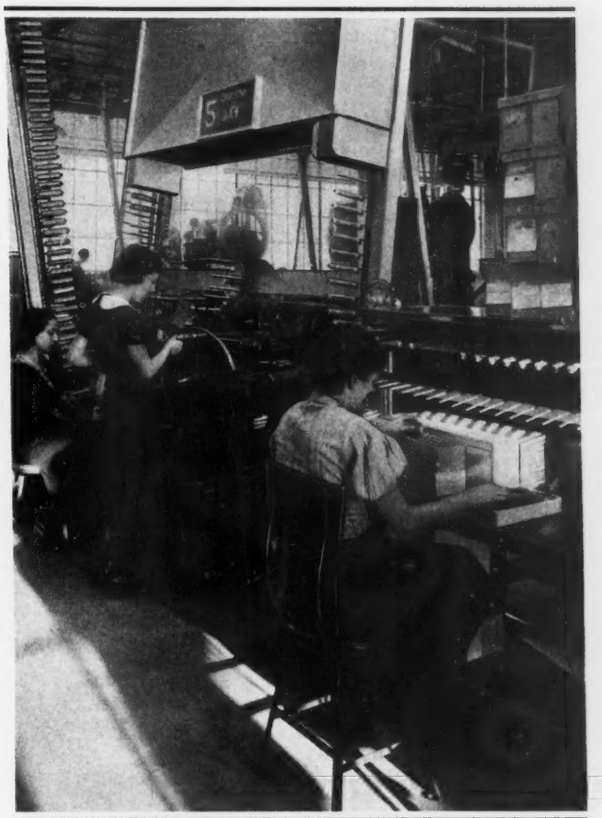


Fig. 6. Each Load of Slugs is Weighed as Shown, before Starting out on its Journey to the Tube-extruding Machines

Fig. 7. Lacquering and Packing into Shipping Boxes is the Last Step in the Process of Manufacturing the Collapsible Tubes



that the attendant of the slug storage room knows which machines are in need of slugs. He fills the bucket of the Monorail hoist, as shown in Fig. 5, with slugs of the proper size for the machine to be supplied, weighs the load on the scale seen in Fig. 6, and presses a button on the pendent switch of the hoist to start the load on its way.

The attendant then steps to the panel seen on the wall in Fig. 6 and sets a switch to break the electric current in the hoist rail directly above the hopper of the machine to which the slugs are consigned. When the hoist reaches that machine, it stops automatically and the foreman opens a slide at the bottom of the hoist bucket to allow the slugs to drop directly into the machine hopper. He then presses a button on the hoist pendent switch to return the hoist with its empty bucket to the slug storage room. Red lights show on the panel board in Fig. 6 for each switch set, in order to guard against two or more switches being set at the same time.

Collapsible Tubes are Extruded at High Rates of Production

Each of the tube-extruding machines is set up with its own auxiliary machinery for finishing, painting, drying, printing, and lacquering the tubes. Thus, from the moment that a slug leaves the hopper of the extruding machine, the piece of tin moves continuously to the point where it is packed as a finished tube in a pasteboard box for shipment. In Fig. 9 may be seen the chute down which the slugs move from the hopper to the machine proper. They are pushed by a horizontally reciprocating plunger around a U-shaped path to a die.

Here tubes are extruded by the pressure exerted vertically by punch *A* on each slug as it lies in the die. Between each stroke of the press, the punch swings forward about 30 degrees, during which movement a jet of compressed air is released to force the tube from the punch and into the chute at the front of the machine. The tubes roll from this chute on a conveyor which carries them toward the operator.

When the tubes roll from the end of this conveyor, they are automatically picked up by a second machine unit that faces the tubes on one end, cuts them to length, threads one end to receive a cap,

Fig. 8. A Conveyor that Returns Scrap to the Melting Department and Delivers Boxes to be Filled with Tubes

and applies a coating of paint. When the tubes have completed this stage, the operator transfers them to a conveyor that carries them to a baking oven on the floor above.

Tube Drying has been Reduced from One Day to One Hour

Each baking oven is maintained at a suitable temperature for quick drying. The temperature of the atmosphere surrounding the ovens is kept at about 120 degrees F., so as to save furnace heat by acting as an insulator against the normal temperature of the working department. The tubes remain in the oven for about thirty minutes, at the end of which time the paint has been thoroughly dried. The tubes then come down to the girls seen in the background of the heading illustration. The first girl transfers the tubes to a machine that prints on them the trade name of the product with which it will later be filled, the name of the manufacturer, etc. The second girl puts the printed tubes on another conveyor that takes them to a second drying oven, where they remain for about thirty minutes.

When the tubes leave the second oven, they come down to the group of girls seen in Fig. 7 and in the background of Fig. 9. One of the girls runs the tubes through a lacquering machine, and the second places them on a conveyor that carries them up through a ventilating hood connected with the outside air. The third girl puts the tubes in boxes for shipment, after first screwing caps on any tubes that may reach this point without them. The lacquering operation is omitted on tubes for some manufacturers.

The high efficiency of the manufacturing methods here described will be realized from the fact that not much over an hour elapses from the time the slugs are blanked until the completed tubes leave the shipping point.

Scrap from the extruding, painting, printing, and lacquering machines is stored in an overhead room until Saturday mornings, when it is refined to be used again. The scrap reaches the melting room by means of the conveyor seen in Fig. 8. Supplies for the groups of tube-making machines, such as paint and packing boxes, are also stored in the mezzanine department and issued to each machine group at the beginning of a shift.

Fig. 9. The Slugs are Extruded into Tubes, which are Faced, Cut to Length, Painted and Have a Cap Screwed on before They Reach Human Hands

Fundamentally, the process of extruding collapsible tubes is the same as it was a score of years ago. However, the rate of extrusion has been greatly increased, and in the plant described, sound engineering has effected vast improvements in material-handling methods and in working conditions, with a reasonable expenditure of capital.

* * *

A two-reel motion picture entitled "The Prosperity Process," produced by the International Acetylene Association, 30 E. 42nd St., New York City, shows the application of the oxy-acetylene process of welding and cutting metals to a wide range of repair, reclamation, and production work. The picture is suitable for technical society meetings, engineering colleges and technical schools, superintendents' meetings, foremen's clubs, and similar gatherings. It is available in the 16-millimeter size, and may be borrowed by addressing the secretary of the Association.

* * *

Last year, 340,000,000 ordinary incandescent lamps were sold in the United States, in addition to 275,000,000 miniature lamps.

Motor Drives for Modern Machine Tools

By GEORGE H. HALL

How Various Types of Improved Motors are Being Applied to Meet the Requirements of Modern Metal-Cutting Machines

ABOUT a quarter of a century ago the use of individual electric motors for the operation of machine tools became generally feasible. Since that time great progress has been made in the design and construction of both machine tools and the motors suitable for their operation. What may today be considered general practice in this field is found to be very different from that which prevailed when motors were first applied to machine tools.

The continued development of high-speed tool steel and carbide cutters, together with the greater speeds and heavier cuts thus made possible, has resulted in the design of machines of far greater capacities. There has also been a tendency toward more specialized types of machines for performing a more limited range of work, but capable of doing that particular work at greatly increased speed and efficiency.

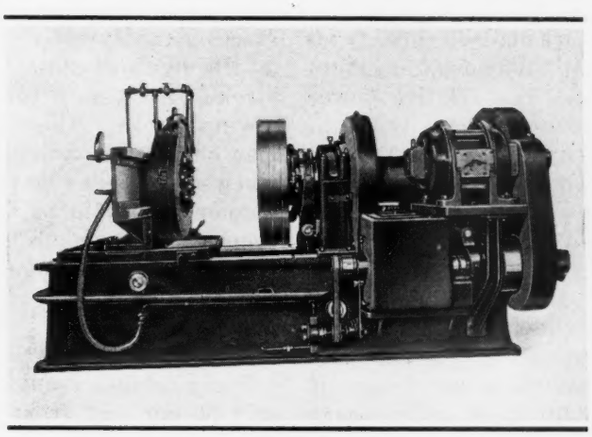


Fig. 1. Chain Drive Pipe Threading and Cutting Machine with Motor Mounted on Bracket. Photo, Courtesy Landis Machine Co., Inc.

Developments in the design of motors and the methods of their application have kept pace with this trend in machine tool design. In the beginning, nearly all motor applications employed direct-current motors. This was due mainly to the fact that nearly all of the private generating plants of that time were of the direct-current type. Also, a large proportion of the public utility companies were supplying direct current only. At the present time, only a comparatively small number of utility companies supply direct current, and undoubtedly they will discontinue this within the next few years. Private plants are also tending more and more to employ alternating current.

The development of this condition during the last quarter of a century has placed before the motor manufacturer a demand for a wider range of types of alternating-current motors to meet the varying requirements of the machines with which they are to be used. To a great degree, this demand has been successfully met. While there are still a few types of machine tools that are better served by the wide and closely controlled speed range obtainable with the direct-current motor, there is now an alternating-current motor having characteristics suitable for driving practically all general types of machine tools.

Planers, with their unusual demand for variable speed, high starting torque, and constant reversal, constitute one of the types of machines for which the direct-current motor continues to be generally used. The practice, however, when the current supplied is alternating, is to employ a motor-generator set in which an alternating-current motor drives a direct-current generator, and this, in turn, furnishes the current for the operation of the planer motor. This permits the installation of the equipment on the regular alternating-current lines, at the same time providing all of the advantages of a direct-current drive. Deceleration, acceleration, and reversal of the motor in such an installation can be accomplished by suitable control of the field of the generator unit of the motor-generator set.

The type of motor most generally used for driving a machine tool is the standard squirrel-cage induction motor, operating at a constant speed and giving comparatively close speed regulation from no load to full load. This type of motor, in general, corresponds to the direct-current shunt motor. In capacities up to and including five horsepower it can be thrown directly across the line, while in the larger sizes a starting compensator is employed to permit starting on reduced voltage, thus reducing the starting current.

A modification of the squirrel-cage motor known as the low starting current type has similar characteristics to the regular induction motor, but, owing to its low starting current demands, it can be thrown across the line without a compensator in sizes up to 30 or 40 horsepower. The maximum capacity of a motor of this type that can be used for any application is usually determined by the policy of the public utility line upon which it is used.

The squirrel-cage motor is generally used with machines operating at a constant speed and with those in which the speed adjustment is obtained by the use of change-gears. This class of machines comprises lathes, boring mills, milling machines, drills, and similar tools in which the operating requirements call for a practically constant supply of driving power.

Table 1. Relative Power Output of Constant-Horsepower, Constant-Torque, and Variable-Torque Motors

Speed, Revolutions per Minute	Constant-Horsepower Type Motor	Constant-Torque Type Motor	Variable-Torque Type Motor
1800	5 H.P.	5 H.P.	5 H.P.
1200	5 H.P.	3.33 H.P.	2.22 H.P.
900	5 H.P.	2.5 H.P.	1.25 H.P.
600	5 H.P.	1.66 H.P.	0.55 H.P.

When motors providing speed variation are needed to supplement the speed range obtained by change-gears, a multi-speed induction motor is employed. This type of motor is so designed that the speed can be adjusted by various groupings of the stator windings. This change in grouping permits the operation of the motor, at will, as a four-, six-, eight-, or twelve-pole machine, giving speeds of 1800, 1200, 900, and 600 revolutions per minute, respectively, on sixty-cycle service.

These multi-speed motors are made in three types of ratings, known as constant horsepower, constant torque, and variable torque. The relative power output of five-horsepower sizes in these types, at different speeds, will be seen from Table 1. The relative power outputs shown in this table may be used as a guide in selecting a motor that will meet the actual power demands of the machine to be equipped.

Multi-speed motors can also be obtained for a speed range of 2 to 1 in cases where this ratio is sufficient for the requirements of the machine. The multi-speed motor is suited to all classes of machines for which the constant-speed squirrel-cage motor is employed.

For heavy starting duty, another modification of the squirrel-cage motor is especially designed to provide a very heavy starting torque. This corresponds to the direct-current, compound-wound motor and, similar to it, does not have as close speed regulation as the standard constant-speed motor. In other words, as the starting demand increases, the "slip" or slowing down of the motor becomes greater, thus reducing the speed. This is, however, satisfactory for the purpose for which this type of motor is generally used. It is employed for moving tailstocks on lathes, cross-heads on boring mills, and work of this character. As the service period through which the motor is operated for such purposes is necessarily short, an intermittently rated motor is usually satisfactory.

This heavy starting-duty motor is also employed for the operation of machines equipped with flywheels to supply the reserve energy for the completion of the stroke, which comprises the actual work of the machine. The duty of the motor, after starting the flywheel, is to maintain its speed and, as the flywheel slows down at the climax of the stroke, to restore it to its full speed before the following stroke. This requires a 50 per cent overload on the motor at the completion of the stroke, when energy must be restored to the flywheel. Consequently, the slip, or slowing down of the motor on overload, corresponds to the demand of the machine and renders this type of motor especially suited to this class of service. The kinds of machines with which this type of motor is used are punches, shears, bulldozers, etc.

For machines requiring a speed variation of not over 50 per cent from maximum to minimum, the slip-ring or wound-rotor type of motor is applicable. The speed reduction is obtained by the introduction of resistance in the secondary, or rotor, winding. The slip-ring motor corresponds in general to the

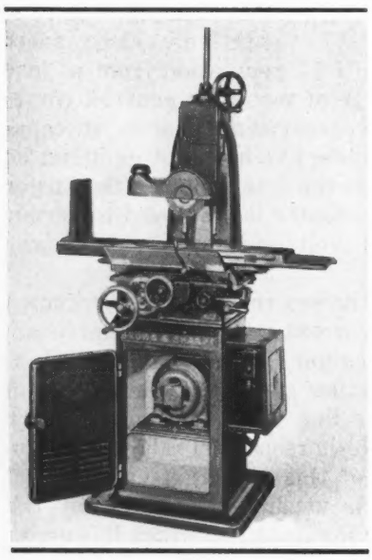
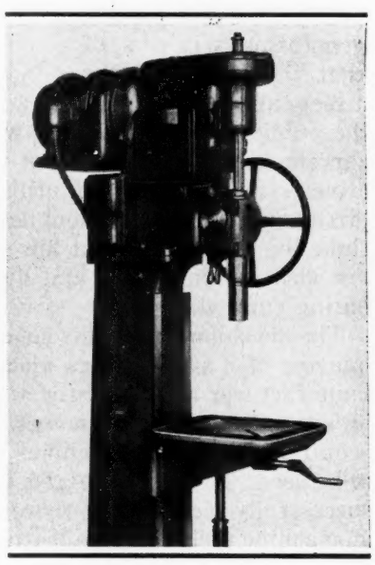


Fig. 2. (Left) Surface Grinder with Motor Enclosed in Base. Photo, Courtesy Brown & Sharpe Mfg. Co.

Fig. 3. (Right) Drilling Machine Equipped with Flanged Type Motor. Photo, Courtesy Barnes Drill Co.



direct-current, compound-wound motor, and is desirable for use where the starting load is heavy and the running load is more or less intermittent. This motor has considerable slip on overloads, which particularly suits it to the type of duty mentioned. The speed regulation of this motor is poorer than that of the squirrel-cage motor, so that it is not so well suited as the multi-speed motor for supplying variable speed to machines where close regulation at any set speed is desired.

Slip-ring motors are most successfully employed on pipe threading and cutting machines, as well as on punches and shears, where a limited speed variation is required. It should be borne in mind that the speed reduction depends upon the actual load. A motor having a secondary resistance of suitable capacity to reduce the speed 50 per cent on full load would not give this reduction if the torque at the lower speed was less than at full load. It is therefore necessary that the regulating resistance for use with this type of motor be carefully designed for the particular load conditions under which the machine is to operate.

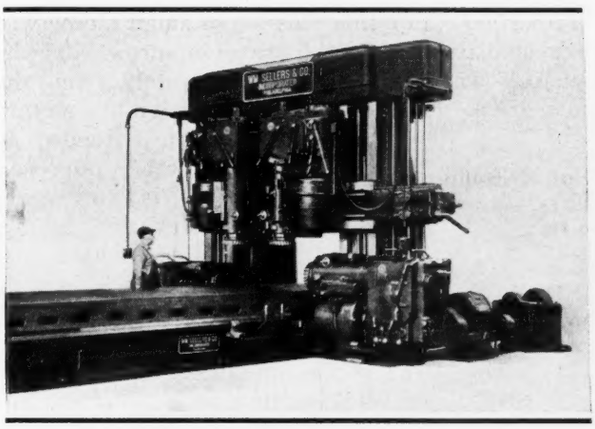


Fig. 4. Planer Type Milling Machine with Multiple Driving Equipment of Nine Motors. Courtesy William Sellers & Co., Inc. (Photo, General Electric Co.)

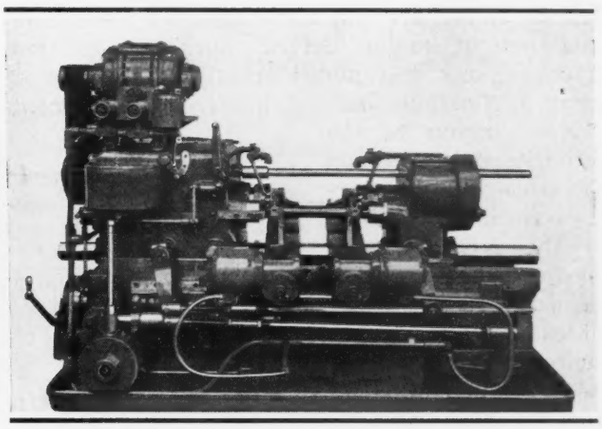


Fig. 5. Milling and Centering Machine with Individual Motors for Operating the Work - holders. Photo, Courtesy Jones & Lamson Machine Co.

Methods of Applying Motors to Machines

The mechanical application was given but little consideration when electric motors were first used for individual drives. The motor was usually placed on the floor at the back of the machine or, at best, mounted somewhere on a set of strap-iron brackets. The machine itself was usually of the standard type, to which the motor was belted.

With the ever increasing demand for individually equipped machine tools, the builder began to give the matter of motor application the same attention that had been given to other features of design. The aim now is to have the motor an integral part of the machine, whereas formerly it had appeared to be simply stuck on. The three principal methods of applying motors to machine tools are given in the following:

(a) *Motors Mounted on Brackets*—While this is but little different from the earliest practice, the machine builder now uses cast brackets, as shown in Fig. 1, so that this arrangement no longer appears to be a crude makeshift, but is very plainly a well designed part of the machine. As the brackets are usually well above the floor, this method of mounting has the advantage of removing the motor from the dirt and dust to which it was exposed in the early method of floor mounting. The drive from the motor, when bracket-mounted, may be by chain, V-belt, or by ordinary flat belt, in some cases with an idler pulley to compensate for the necessarily short distance between the motor and the machine pulley.

(b) *Motor Mounted in Base*—In order to remove the motor from any and all sources of dirt, oil dripping, and accidental injury, as well as to improve the general appearance of the machine, the method of mounting the motor in the base of the machine itself, as shown in Fig. 2, is now being followed by many machine tool builders. This produces a compact and pleasing appearance. Access to the motor is obtained by a swinging door, and when proper provision is made for the ventilation of the motor, this method proves very satisfactory. The drive from the motor to the machine may be arranged as in the case of the bracket-mounted motor, or the motor may be directly connected to the main driving shaft of the machine.

(c) *Flanged Motor*—With the idea of making the motor a more unified part of the machine, a flanged type of motor has been developed. In the construction of such motors, the front end shield is enlarged into a flange, which is bolted to a seat on the side

of the machine, as shown in Fig. 3. The motor shaft, extending into the interior of the machine, may be provided with a pulley or gear or it may be directly connected to the main driving shaft, as the design of the machine dictates.

Standardization of Motor Dimensions

Formerly, the machine tool builder faced the problem of designing his machines to suit motors of widely differing dimensions for corresponding capacities. The make of motor was generally specified by the purchaser of the machine, and if the manufacturer made up brackets to accommodate any one of a dozen makes of motors, they would not suit any of the other eleven, although the horsepower and the speed were the same for all. This naturally made it impossible for the machine tool builder to prepare standard parts for the accommodation of motor drives. Such a condition, of course, not only added greatly to the cost of motor applications, but also hindered development.

Now, owing to the activities of the National Electrical Manufacturers Association (known as the NEMA), motor dimensions are standardized. As practically all leading motor manufacturers have adopted the recommendations of this Association, the machine tool builder can now design his machine without knowing what particular make of motor will be used. If the horsepower and speed are determined, he knows that the shaft diameter, shaft extension, height of shaft from base, and size and position of bolt holes will be the same, regardless of the make. As this standardization applies to the shaft and mounting dimensions of flanged type motors, as well as of the usual horizontal type, he can arrange the mounting surfaces and lay out the attachment for drilling with the same degree of certainty.

In the matter of speeds, the frequency of the current upon which the motor is to be used will be the determining factor. The generally employed frequency in this country is sixty cycles, although in a limited number of localities a frequency of twenty-five cycles may still be found. In foreign countries, a frequency of fifty cycles is most generally used.

The accepted speeds for sixty-cycle motors for general application up to 50 horsepower, as recommended by the NEMA, are as follows: From 1 to 40 horsepower, 1800 revolutions per minute; from 3/4 to 50 horsepower, 1200 revolutions per minute; from 2 to 50 horsepower, 900 revolutions per minute; and from 10 to 50 horsepower, 600 revolutions per minute. These are the synchronous speeds. They come within the recommendations for belt drives, but for gear connection, the maximum speeds should be restricted to the following limitations: Up to a maximum of 5 horsepower, 1800 revolutions per minute; 25 horsepower, 1200 revolutions per minute; 50 horsepower, 900 revolutions per minute.

The early individual motor applications provided for a single motor which furnished power only for driving the main shaft or spindle of the machine. Auxiliary operations, such as the movement of the tailstock, elevation of cross-rails, and cross-head travels, were performed manually or by geared connection to the main drive.

Multiple Motor Equipment Simplifies Power Problems

The first use of independent auxiliary motors was probably for the movement of tailstocks on large lathes. For this purpose, a small motor was connected directly to the traverse screw, and the tailstock was thus operated separately from the main drive. From this, the use of auxiliary motors has been extended to many other purposes, until it is now quite customary for a machine tool to have separate motors for a wide variety of purposes. The employment of multiple motors is no longer limited to auxiliaries, but in types of machines that have more than a single cutting head, it is customary to equip each head with an individual motor.

Table 2. Recommended Power Equipment for Engine Lathes

Swing of Lathe, Inches	Twenty-five Years Ago		Today	
	Average Weight Lathe	Heavy Lathe	Average Weight Lathe	Heavy Lathe
12	1/2 H.P.	1 H.P.	2 H.P.	3 H.P.
14	3/4 H.P.	1 H.P.	2 H.P.	3 H.P.
16	1 H.P.	2 H.P.	3 H.P.	5 H.P.
18	2 H.P.	3 H.P.	5 H.P.	7 1/2 H.P.
20	3 H.P.	7 1/2 H.P.	7 1/2 H.P.	10 H.P.
24	5 H.P.	7 1/2 H.P.	10 H.P.	15 H.P.
30	5 H.P.	10 H.P.	15 H.P.	20 H.P.

As evidence of the extent to which multiple equipment is being employed, the case of a planer type milling machine may be cited as an illustration. This machine, as shown in Fig. 4, has four cutting heads, each independently equipped, and the complete electrical equipment consists of nine motors disposed as follows: Four cutter-driving motors, 20 horsepower each; one table-feed motor, 10 horsepower; one head-feed motor, 7 1/2 horsepower; one rail-elevating motor, 7 1/2 horsepower; one cutting-compound motor, 1 horsepower; one oil-pump motor, 1/2 horsepower. This is, of course, a machine of large capacity, but even on smaller machines, use is being made of auxiliary motors for many purposes. Fig. 5 shows two small auxiliary motors employed for the operation of work-holders. Many of the medium capacity lathes and boring mills have auxiliary drives for operating the oil-pump, which involves a small expenditure of power, but which would entail a rather complicated driving arrangement if operated from the main driving motor.

It is impossible to formulate any fixed rules by which the motor power needed by any line of machines can be definitely determined. If the motor selected is of insufficient power to match the capacity of the machine to which it is applied, it will be

impossible to get the full amount of work out of the machine, while if the machine is over-powered, damage may result from its being operated at heavier loads than it is suited to carry.

In general, it is the practice today to hold the machine tool manufacturer responsible for the selection of motors of suitable capacity for the machines with which they are to be used. Continual tests in the factory of the manufacturer place him in the best position to decide the horsepower needed for the operation of his machines. The general recommendations for equipping machines which the owner wishes to change from belt drive to motor drive are given in Data Sheets Nos. 277 and 278 on page 648-A of this number. These tables will serve as a guide in selecting the proper motors, and they will also aid in calculating the total connected load when a number of belt-driven machines are to be operated as a group from a single driving motor.

In using these tables, consideration should be given to the age and condition of the machine to be equipped. The data given are based upon the latest recommendations of a number of machine tool manufacturers and may be considered up to date as applying to new machines. Old machines would be powered at considerably lower figures, as such machines were designed before the present demand for high-powered machines. As an illustration of the increase in power specifications, Table 2 gives recommendations for lathes, prepared about twenty-five years ago, compared with similar data of the present day.

The figures given in Data Sheets Nos. 277 and 278 should be used with judgment, as the actual power required for any machine depends upon a number of factors, such as the make of the machine, the character of the work to be done, and the class of service for which it is to be used, that is, whether it is to be used for the continuous production of a certain class of work or whether it is to be used for general work of a mixed nature. The figures are, therefore, only guides, but they represent present-day average practice, as specified by leading manufacturers.

For the data used in compiling the tables and for the photographs illustrating the different types of applications, acknowledgement is made to the following companies: Barnes Drill Co.; Brown & Sharpe Mfg. Co.; The Bullard Co.; Cincinnati Milling Machine Co. and The Cincinnati Grinders, Incorporated; General Electric Co.; Jones & Lamson Machine Co.; Landis Machine Co., Inc.; The Lodge & Shipley Machine Tool Co.; and William Sellers & Co., Inc.

Ball-Bearing Cup Made in Eighteen Seconds

The average shop man, picking up the roller-skate ball-bearing cup shown at the left in Fig. 1, would jump to the conclusion that it was a product of the power press. This would be a natural mistake, because the walls are thin enough to be made of sheet metal, and the flanged faces at the front and back have the appearance of a stamping. A closer inspection, however, would show that one flange is approximately 5/64 inch thick, whereas the other is only about 1/32 inch thick, and at the knurled corner, the thickness of the material is about 1/8 inch—so that the part could hardly be a stamping.

If it were known that the part was made from bar stock, the question would then arise as to how the metal could be removed from the inside of the piece within a tolerance of 0.002 inch on a production basis. This ball-bearing cup is made from a 1 1/4-inch No. 1020 S A E steel bar to the dimensions shown in Fig. 2, on an Acme five-spindle automatic screw machine, which is built by the National Acme Co., Cleveland, Ohio. The production rate is 200 pieces an hour. The inside of the part is buffed after the screw machine operation to obtain a smooth surface for the balls. Another part is assembled into the cup to serve as an inner race.

The first cuts are taken on this part in the lower rear position of the work-spindle carrier. Here a 15/16-inch drill, mounted on the main slide of the machine, advances to rough out the end of the bar stock to the approximate inside diameter of the part. At the same time, a forming tool on the rear cross-slide shapes the work as shown in the upper view of Fig. 3.

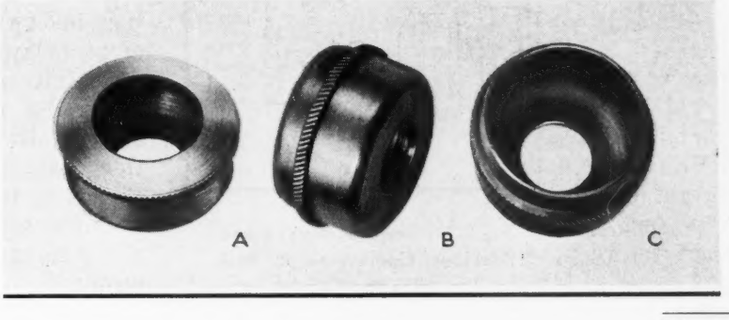


Fig. 1. A Ball-bearing Cup that is Produced Complete in an Automatic Screw Machine, and Two Partially Completed Cups

When the work is indexed to the lower front position of the work-spindle carrier, a 9/16-inch drill on the main tool-slide advances into the center of the bar to produce the hole for one of the flanges. At the same time, a counterbore in back of this drill takes a second cut on the large inside diameter of the part, and a knurling tool, also on the main slide, cuts the knurl on the maximum circumference of the part. In addition, a tool on the front cross-slide finish-forms the external surface.

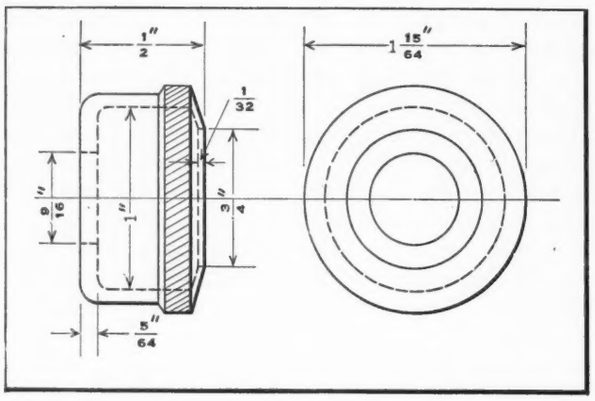


Fig. 2. Detail Drawing of the Roller Skate Ball-bearing Cup Shown in Fig. 1

When the part reaches the upper front position of the work-spindle carrier, a tool on the main slide advances to take a shaving cut on the inside surface, finishing it within the specified tolerances. The part now has the appearance shown at *B* and *C* in Fig. 1, except that it is still integral with the bar stock. The work then indexes to the top center position of the carrier, where a tool on the top slide descends and starts to spin down the front curved flange by turning down the outer edge of the piece. This step is completed in the same position of the work-spindle carrier by a tool mounted on the main slide.

In the upper rear position of the carrier, a tool on the main slide faces this flange to the desired shape, and a tool on the side slide cuts the part from the bar.

In taking the various cuts on this part, the bar stock revolves at a speed of 122 surface feet per minute, and the main tool slide has a feed of 0.006 inch per spindle revolution. The time per piece is eighteen seconds.

* * *

The initial lubrication of General Electric 1/6 and 1/4 horsepower washing machine motors is designed to last for the life of the washing machine. The right lubrication is provided at the factory and no provision is made for re-oiling.

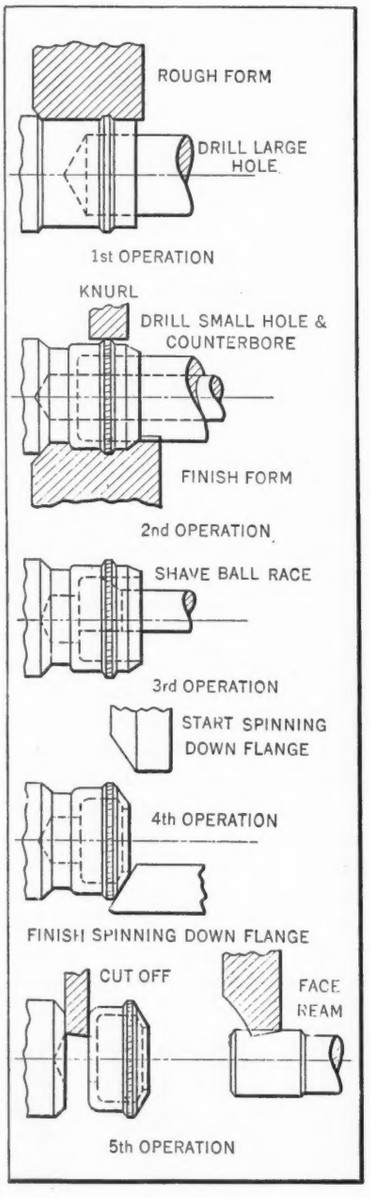


Fig. 3. Sequence of Screw Machine Operations on Ball-bearing Cup

The German Machine Industry

According to a report by Rolland Welch, assistant trade commissioner, made public by the Bureau of Foreign and Domestic Commerce, Washington, D. C., the machinery imports into Germany during the first quarter of 1934 showed an increase of nearly 50 per cent over the first quarter of 1933. German exports, however, continue at a very low ebb, in most cases below those of the first quarter of 1933. This affects the machinery industry of the country in a very serious way, because some five years ago between 40 to 60 per cent of the production went to foreign markets, while now foreign sales amount to only about 10 per cent.

Nevertheless, due to domestic orders, the index of the industry for January, 1934, stood at 54.8, taking the monthly average for 1928 as 100. The machinery plants have reached approximately 50 per cent of normal employment, the industry in January running on an average of 44.5 hours weekly, compared with 40 hours weekly in January a year ago.

The price index figure for machinery is 86.8, taking 1928 prices as 100. This is a slight decline from the price index figure for January, 1933, which was 88.2. The greatest improvements noticeable at the present time are in the machine tool, conveying and crushing, textile, and agricultural machinery fields.

* * *

National prosperity cannot be promoted by the destruction of property, by the strangling of trade, or by the hampering of production. Prosperity is promoted only by reducing production costs and removing the obstacles to the distribution of the products of soil and industry to the largest possible number of people.

Recent Developments in Brass Die-Casting Methods

Brass Die-Castings Gain Wider Acceptance Through Improved Equipment and New Methods

By HERBERT CHASE
Based on an Interview with W. W. SIEG, Titan Metal Mfg. Co.

BRASS die-castings have been produced on a limited scale in this country for several years and on a wider scale in Europe. Their utility is now well established and the difficulties involved in their production, though still imposing certain limitations, are being overcome. The output of this type of die-casting in the plant of the Titan Metal Mfg. Co. will approximate a million castings this year, with prospects of a growing market. The present article relates in part how this success has been achieved.

Selection of Machine Used for Die-Casting Brass

As a producer of brass alloys and various brass products, including forgings, it was logical that the Titan company should become a producer of brass die-castings. In seeking equipment for the purpose, it was found that the Polak machine had gained considerable success in Europe and several of the company's officials went there early in 1931. They saw the machines under construction at the Polak works in Prague and observed many of them in practical service in several countries of Europe. As a result, they purchased three machines which are now installed at the company's plant in Bellefonte, Pa., where they have been in continuous use for more than two years.

These machines differ radically from the die-casting machines commonly used for alloys having a lower melting point. The melting furnace is not a part of the machine, but is an independent unit. Metal is ladled by hand into the pressure cylinder of the machine in a paste-like rather than in a liquid state, prior to each "shot." The ladle contains a little more metal than is required for the casting, and the charge is held momentarily in a cylinder on top of an ejector plunger which at that instant covers the gate leading to the die. Above the cylinder is a hydraulic ram controlled by a valve which the operator opens immediately after placing the charge in the cylinder.

As the ram descends, it forces the ejector plunger downward, uncovering the gate. When the ejector cylinder comes to rest against its seat, the ram continues downward and exerts a pressure amounting to 5000 to 6000 pounds per square inch on the metal, which is still in a semi-liquid or plastic state. This pressure forces the bulk of the charge into the die (which, of course, is locked in its closed position), producing the casting very much the same as in other types of die-casting machines.

Immediately after the casting is made, the ram is withdrawn and the ejector plunger is forced upward, shearing off the sprue and ejecting the slug of solid metal that remains in the cylinder. The die is then opened and the casting ejected, along with the sprue attached to it. This completes the cycle, and the machine is ready for another shot as soon as the die is closed.

Die motion is also effected hydraulically with

Table 1. Composition and Properties of Copper-Base Alloys for Die-Casting

Composition and Properties	Yellow Brass	Tinicosil* No. 20 (Patent Pending)
Copper, Per Cent	57.0 to 59.0	42.0
Zinc, Per Cent	40.0 to 42.0	41.0
Tin, Per Cent	0.50 to 1.50	.....
Aluminum, Per Cent	0.10 max.	.....
Lead, Per Cent	0.75 max.	1.0
Manganese, Per Cent	0.25 max.	.....
Nickel, Per Cent	.....	16.0
Tensile Strength, Pounds per Sq. In.	60,000 to 70,000	85,000 to 95,000
Impact Strength, Charpy, Ft. Lb.	> 33	.....
Yield Point, Pounds per Sq. In.	35,000 to 45,000	65,000 to 72,000
Elongation, Per Cent in 2 In.	5 to 10	10 to 20
Reduction of Area, Per Cent	15 to 20	10 to 18

Properties	Yellow Brass	Tinicosil* No. 20 (Patent Pending)
Shearing Strength, Pounds per Sq. In.	50,000 to 55,000	.....
Brinell Hardness	120 to 130	160
Rockwell Hardness	.....	B-90
Specific Gravity	8.47	8-45
Wt. per Cu. In., Lb.	0.305	0.305
Melting Point, Deg. F.	1650	1675
Solidification Shrinkage, In. per Ft.	3/16	3/16
Specific Electric Resistance	5.75 to 6.0	.....
Machineability	Fair	Good
Corrosion Resistance	Good	High
Bearing Qualities	Poor	.....

*Registered trade name, Titan Metal Mfg. Co.

controls which are convenient to the operator. Although the cycle takes some time to describe, it is effected quite rapidly. On the smallest machine used by the Titan company, which makes castings up to 10 1/2 ounces in weight, about 200 shots per hour can be made. The largest machine makes 70 shots per hour and produces castings up to 11 pounds in weight. The intermediate size machine makes castings up to 1 1/2 pounds.

Table 2. Composition and Properties of Copper-Base Alloys for Die-Casting

Composition and Properties	White Brass (Nickel-Silver) SAE No. 42	Aluminum Bronze SAE No. 68B
Copper, Per Cent	55.0 to 64.0	89.50 to 90.50
Zinc, Per Cent	Balance	0.2 max.
Aluminum, Per Cent	.....	9.50 to 10.50
Nickel, Per Cent	18.0	.....
Iron, Per Cent	0.35	1.00 max.
Impurities, Per Cent	0.25 max.	0.5
Tensile Strength, Pounds per Sq. In.	30,000	80,000*
Yield Point, Pounds per Sq. In.	.....	50,000*
Elongation, Per Cent in 2 In.	20	4*
Brinell Hardness	.....	160
Bearing Qualities	.....	Good

*As heat-treated.

These machines are designed to operate on a line pressure of 1800 pounds per square inch, which is supplied by a Smith motor-driven triplex hydraulic pump used in combination with an air-loaded accumulator. In this instance, the pump has sufficient capacity for several machines, in addition to the three now in use.

Method of Melting and Holding Metal at Proper Temperature

Metal for casting is heated in W. S. Rockwell electric furnaces, one of which is provided for each machine. As a most important consideration in the success of brass die-casting production is to have the metal at the correct temperature, all the furnaces are provided with pyrometers and automatic thermostatic controls which hold the temperature within the required range, namely, 1600 to 1725 degrees F. in the case of the copper-base alloys most used. In general, the temperature of the furnace is held within about 10 degrees of the mean temperature desired.

The furnaces at the machines are recharged with molten metal, as required, from separate furnaces in an adjacent melting room. A few slugs from castings already produced may be mixed into the new charge if its temperature is above that normally held in the electric furnace. Scrap and defective castings are usually held to around 6 to 10 per cent, and of course are remelted, the net loss amounting to around 4 per cent of the metal charged into the furnaces. All scrap is segregated and a check on the analysis of the metal is made at least once a day.

Castings ejected from the dies are allowed to fall into a chute, and when cool are removed for cleaning. They usually require very little machine work aside from the removal of gates and fins. Grinding and polishing are necessary, of course, if the castings are to be plated, but since the alloys used are highly resistant to corrosion, surface finishing is seldom required, except for appearance or decorative purposes.

Brass die-castings can be made within closer dimensional limits and in much more complicated shapes than brass forgings, and they can be cored readily. External threads of ten or coarser pitch can be die-cast, but are likely to require chasing for close fits. In some instances, important dimensions can be held within limits of $\pm$ 0.003 inch or closer. Wall thicknesses of 1/16 inch or less are possible in small castings, but the minimum may be double this for larger ones. The minimum diameter of core depends somewhat upon its length, as long cores of small diameter are likely to be bent. Short cores of 3/16 inch diameter can be used, but drilling of smaller holes is usually advocated. The draft on cores and on side walls is preferably about 0.020 inch per inch of length. Hollow elbows can be die-cast by using a core from each side, and even intersecting cores for making T-shaped and other castings are feasible in some cases.

The Design of Dies for Brass Castings and Materials Used in Their Construction

The die construction is very similar to that for other types of castings, except that the higher temperatures required for brass castings make it necessary to use special heat-resistant steel, which must be heat-treated. Even then, the die life is much shorter than for zinc-base or even aluminum-base die-castings. This, in fact, has been and still is one of the chief drawbacks to copper-base die-castings.

Even the best steel available checks, and considerable die dressing is required if the specification calls for very smooth castings and the quantity is quite large. Maximum die life is usually placed at about 20,000 to 50,000 pieces, during which considerable redressing is required to maintain a smooth finish. This, however, is well within commercial limits, as there are a great number of brass parts that are required in smaller quantities and can be produced by die-casting more accurately and with greater economy than by any other feasible method.

Steels of the "semi-high-speed" type containing from 10 to 12 per cent tungsten have proved most satisfactory for dies. One of the most successful has the following analysis: Carbon, 0.30 to 0.40 per cent; chromium, 1.75 per cent; vanadium, 0.50 per cent; tungsten 10 to 12 per cent. As in much other die-casting work, nearly every die presents a new problem in respect to the gating and venting required to avoid excessive porosity and insure per-

fect castings. This usually demands some experimenting to secure best results, but when the correct combination has once been found, uniform castings are produced if care is taken to maintain the metal temperature and other conditions remain constant.

Physical Properties of Die-Casting Alloys

Several alloys are available for die-casting. They include, besides the usual yellow brasses, the so-called white or nickel-silver brasses and aluminum bronzes, as well as patented alloys, one of which, called "Tinicosil," has an ultimate tensile strength of 85,000 to 95,000 pounds per square inch. The composition of this and of other copper-base alloys used for die-casting, as well as the physical properties, is given in the accompanying tables.

Except for white brass, with an ultimate tensile strength of 30,000 pounds per square inch (which is about the same as that for die-cast aluminum alloys) the copper-base alloys listed in the table have the highest tensile strength of any of the die-casting alloys, while the best of them has an ultimate strength equal to that of a mild wrought carbon steel. The brass alloys are therefore used primarily where this high strength is desired or where the excellent corrosion resistance that they possess is of importance.

Such castings are excellent for fittings for pipe and most other liquid-handling and gas-handling equipment; for marine fittings; for hardware; for many machine parts; and for a large variety of other applications. In general, they require much less machine work than brass sand castings and are considerably stronger than such castings. They are free from intergranular corrosion and are not subject to the season-cracking which sometimes occurs in stamped and other wrought parts of similar alloys.

Die costs naturally vary with the size and complexity of the part to be die-cast and with the cost of machining the cavity or cavities and such supplementary cores and core-actuating parts as may be required. Simple dies for small parts sometimes cost as little as $100, whereas larger dies for more complex parts may cost $500 or more. In most cases, however, especially when the quantity of castings required is quite large, the saving in machine work on the castings much more than offsets the cost of the die. In addition, because of the superior physical properties of the die-casting, as compared to the sand casting, the former may be made lighter and thus effect a saving in metal costs as well as in machining. Some of the alloys available are very free-machining, and of course none of them have the sand inclusions that tend to dull tools and slow up the machining of sand castings.

Although the cheapest and most widely used brass alloys are yellow in color, those with high nickel content are "white." When nickel or chromium plating wears off from the latter type, there is no "brassy" color to show through. This is an important factor on some types of hardware. In other cases, especially where the retail trade is accustomed to a yellow brass, as in valves and some pipe fittings, for example, the yellow color may prove advantageous.

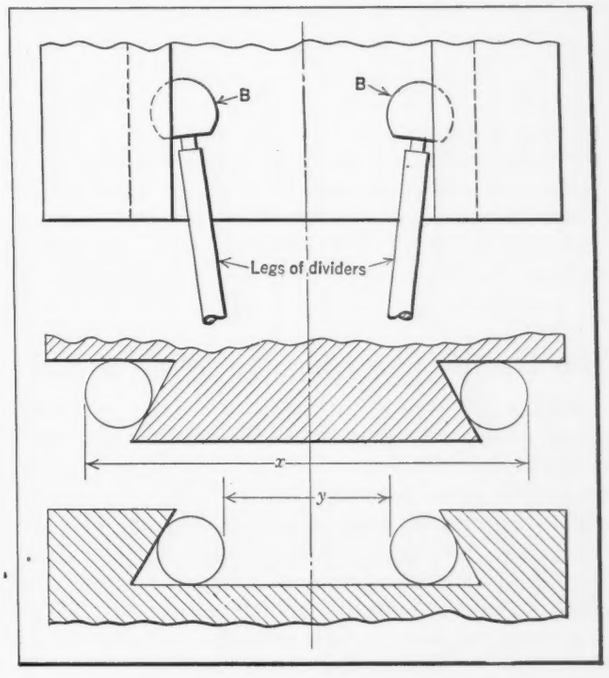
Bronze alloys, other than aluminum bronze, and those containing around 88 per cent copper, ten per cent tin, and small amounts of lead and zinc can be die-cast, but are not in much demand in die-cast form. Aluminum bronze has a strength and hardness equal to manganese bronze, and under some conditions has good bearing qualities. Die-castings of "Tinicosil," which was first developed for forging, have a tensile strength only 10 per cent or less below that of forgings of the same material, but are somewhat less ductile. This alloy is white in color, free-machining, and takes a high polish, besides having high corrosion resistance. It is especially recommended for decorative hardware and ornamental plumbing fixtures.

* * *

Measuring Dovetail Slides with Steel Balls Attached to Divider Legs

By C. W. PUTNAM

After finding dimensions x and y according to formulas on page 1027 of the Eighth Edition of MACHINERY'S HANDBOOK, it is an easy matter to set a micrometer to the dimensions required in measuring dovetails with rolls or balls. A machinist's divider with the legs fitted with steel balls B, as shown in the accompanying illustration, can be easily set to the required micrometer measurement for gaging the dovetail or the dovetail groove.



Method of Gaging Dovetails with Steel Balls Attached to Divider Legs

Engineering News Flashes

The World Over

Steam Turbines with Rotating Boilers

A decidedly novel prime mover has made its appearance in Germany, according to the *Manchester Guardian Commercial*. It was first exhibited to the engineering world at a recent meeting of the Aviation Society in Berlin. Although reminiscent of the Hero turbine—the ancestor of steam engines—it embodies all that is most modern in present-day engineering practice, and is claimed to be the most fully automatic of prime movers.

The most striking new feature of the steam turbine developed by Fritz Huettner, chief engineer of the Klingenberg power station, is that the boiler, instead of resting on a foundation, rotates, the steam-generating system turning around its axis at the rate of a few thousand revolutions per minute. The boiler consists of a series of small U-shaped copper tubes, each of which is a steam generator of its own. The whole set is arranged around a rotor and is connected with an annular water tank fed from the outside.

The rotary boiler is started by hand in the case of small turbines, or by means of an electric motor where larger units are concerned. As the boiler with its set of U-tubes is rotating around its axis, water will flow into the tubes passing by the burners. The water is thus converted into steam, which escapes through two nozzles and sets the boiler system rotating by reaction. Again, the steam jets issuing from the nozzles strike the blades of the turbine rotor, setting this in rotation at a rate three or four times that of the rotating boiler and in the opposite direction. After performing useful work, the steam is condensed on the walls of the housing, through the openings of which it reverts to the water tank, to start on another cycle.

The Electric Eye Helps to Wrap Bread

Let us imagine a large roll of waxed paper for bread wrappers. Printed on the paper is the name of the bread. Before wrapping, the paper must be cut into lengths for each loaf. The cut must come exactly right with respect to the printing. The control of this cutting is the job of an electric eye that watches a small spot printed on each wrapper and adjusts the cutter if this spot tends to drift. This is a relatively easy job for certain colors, but if the spots are printed in red, the electric eye has difficulty in seeing them. A new regulator uses two light sensitive cells connected in a bridge circuit and the accuracy of scanning is greatly increased. Regardless of the color of the spot or variations in the color, the regulator will keep the cut just where it should be.

Gas as Automobile Fuel

Experiments with the use of gas in place of gasoline have been made with considerable success in England. A gas-driven bus is in service on one of the main bus routes in Newcastle. The gas is stored, compressed, in cylinders mounted on the bus chassis. The limitation in the use of gas for this purpose is that the mileage per charge is limited to from seventy to eighty miles. The experimental work, however, is being continued, with the idea of increasing the range of operation with a single charge of gas.

World's Longest Seamless Steel Tube

What is claimed to be the longest seamless steel tube ever made, according to *Engineering*, was recently completed by the British Mannesmann Tube Co., Ltd., at Newport. This seamless steel tube, weighing approximately two tons, is 178 feet in length and 8 5/8 inches in diameter. It was, it is said, produced under normal rolling conditions.

Electric Fan Blades Modeled on Air Propeller

A new type of two-bladed electric fan shows an interesting indication of the influence of one engineering field upon design in another branch of industry. In designing the line of "Barcol" electric fans, made by the Barber-Colman Co., Rockford, Ill., it was found, after much experimentation, that an airplane-type, two-bladed propeller, with the blades wide at the base and narrowing toward the tip, and having a varying pitch or twist, actually delivered more air than the ordinary four-bladed type. Multi-bladed propellers were found by smoke tests to churn the air more than necessary, due to the blades operating too close to one another. Having decided upon the two-bladed type, the engineers departed from past practice by making this redesigned blade from polished sheet aluminum, thereby securing the qualities of both lightness and resistance to corrosion.

Largest Lathe Ever Built

A lathe made for the English Steel Corporation is claimed by the *London Times Trade and Engineering Supplement* to be the largest lathe ever built. It was constructed by Noble & Lund of Felling-on-Tyne. This lathe is driven by a 250-horsepower electric motor and has a capacity for forgings 60 feet long by 7 1/2 feet in diameter. There are said to be sixty-two electric push-buttons for actuating the various power-controlled movements.

Latest Streamline Train

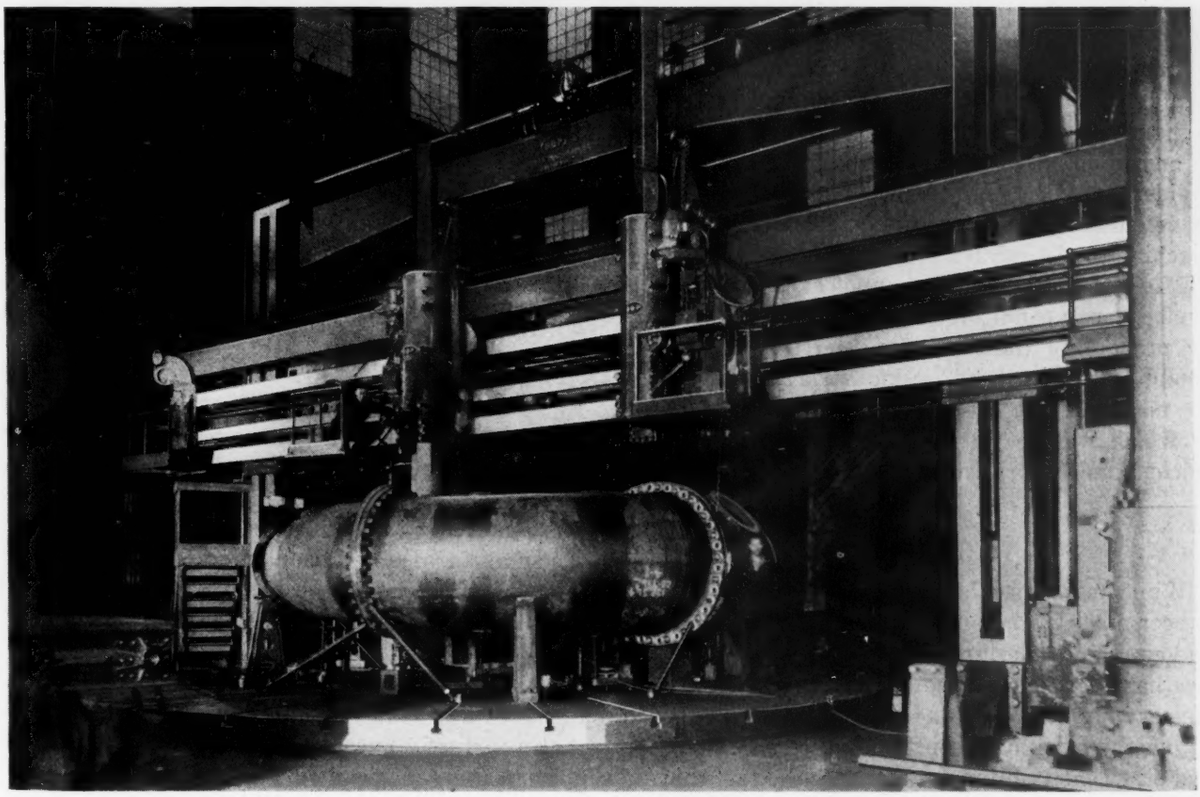
The rapid progress made with streamline trains is exemplified in the new six- and nine-car, streamline, Diesel-engine-driven trains now being added by the Union Pacific Railroad to its streamline equipment already completed. The six-car train, when ready for service, will be brought to the World's Fair in Chicago and will be left there on display during the summer, standing on tracks out of doors south of the Travel and Transport Bldg.

A comparison of this train with conventional railroad equipment is of interest. A conventional steam train of six cars weighs about 600 tons; the new six-car train, 85 tons. A steam locomotive capable of pulling trains at speeds similar to those of the new six-car train weighs about 300 tons; the power unit of the new train, 20 tons. To pull a ten-car standard train at 90 miles an hour would require a 4500-horsepower engine, larger than any now existing. A streamline-constructed train with light-weight cars can be pulled at 90 miles an hour with a 500-horsepower unit. The average modern locomotive must be refueled every hundred miles; the new train, every 1200 miles. The new train operates on roller bearings throughout. Aluminum alloys predominate in its construction It is air-conditioned and the temperature is controlled by thermostats. The cost of the six-car train is about $200,000.

Tractor Output in Russian Plant

The highest daily output of tractors since the beginning of operations at the Kharkov plant was reached early this year, when 165 tractors came off the line in a day. The total production for the first quarter of 1934 was 10,305 tractors.

A 40-foot Niles Boring Mill at the West Allis Works of the Allis-Chalmers Co. Machining a 50-ton Cast-steel Spiral Casing for One of the Two 37,500-horsepower Vertical Turbines Built for the City of Tacoma. The Machine can Handle Work 16 Feet High and 40 Feet in Diameter



EDITORIAL COMMENT

While there is still a great deal of unemployment throughout the nation, many manufacturers in the machinery centers find it increasingly difficult to hire experienced toolmakers and machinists. There are any number of inexperienced men to be had, but properly trained men are scarce.

A machine tool manufacturer—the Hall Planetary Co.—has addressed President Roosevelt on this subject, calling his attention to the fact that under the Code, the machine tool industry is expected to employ but one apprentice to every ten machinists. Mr. Hall, the writer of the letter, believes this provision to be a great mistake.

It is Unwise to Limit the Opportunities for Industrial Training

Quoting from his letter to the President: "Today there are no good machinists out of work and our plant is crippled for this reason. We cannot increase our working force, for the reason that we cannot hire good machinists. . . . Instead of having a clause in our code preventing us from educating apprentices to be good machinists, all machinery manufacturers should have it written into their codes that they are expected to turn out a certain number of good machinists every year—that is, the machinery plants of the United States should be forced to train as many good machinists as possible. . . . Our country is handicapping itself, doing exactly the opposite to any other great power; stopping the machinery builders from training good machinists has the same effect as the opposition to modern production machinery."

Mr. Hall is right. We cannot expect to improve our economic conditions and our standard of living by preventing the education and training of our young men to fit them for industrial work; nor can we maintain our present high standard of living, of which we are justly proud, without the use of efficient machinery.

While much has been said about the great advances made in the producing capacity of machines and equipment designed during the last few years, less has been said of the equally revolutionary advances in appearance made during the same period. An examination of recently designed machine tools and other shop equipment discloses the fact that the design as a whole presents a much more finished appearance. There are not so many projecting parts, gear-boxes, pipes, etc., as in the past. Fewer parts are exposed. In some machines, almost all of the mechanism is enclosed, so that nothing but the operating handles or handwheels protrude from the smooth outline of the machine.

Appearance of Equipment is Becoming an Important Factor

A similar development is evident in practically all classes of engineering equipment; note, for example, how oil burners and furnaces are now designed with smoother outlines and fewer unsightly projecting parts than formerly. Even shop trucks and tote boxes are assuming an outline that shows that attention has been paid to appearance.

In a few instances, the eagerness to consider appearance has led the designer astray, and novelty rather than art appears to have been the guiding motive. But these cases are exceptional, and no one can fail to recognize the great improvement in appearance of the newer types of shop equipment; nor can the machine designer afford to ignore the present trends in "styles."

It has frequently been pointed out in MACHINERY that there are numerous new products that could keep industry busy for a long time as soon as purchasing power and the general well being of the population permit a normal absorption of the products of industrial plants. Among these new developments would be a small farm tractor designed for economical operation on small farms.

Another New Product of Industry That May Open Up Active Markets

In the past, tractors have not been available to the small farmer because of the high initial investment required; but these small tractors, low in initial cost and upkeep, could be made small enough to be useful on farms where larger tractors find no place. Since there are more than three million farms of less than one hundred acres, it is obvious that a virtually untouched field of development lies open to the American farm-machinery industry.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

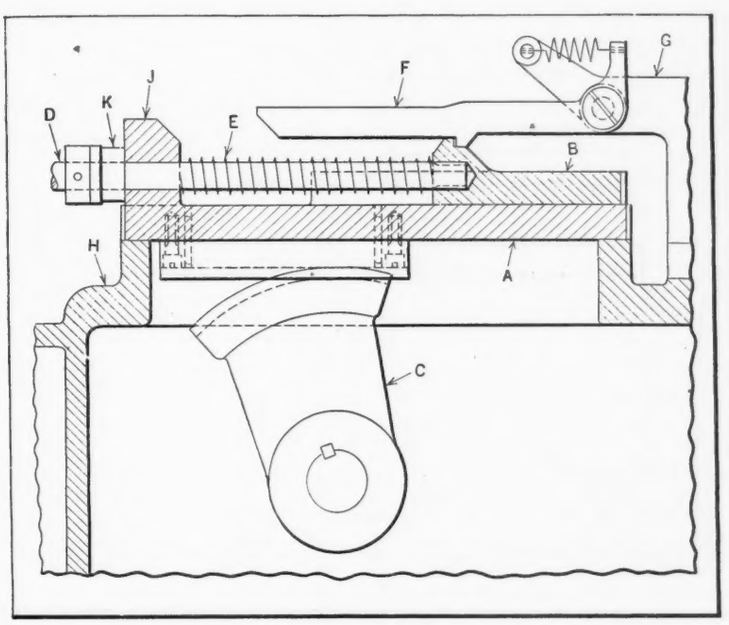
Intermittent Trigger Slide Having a Positive Working Stroke and a Swift Return

By J. E. FENNO

A reciprocating slide having a trigger action is employed on an automatic nut-tapping machine for feeding the nut positively and at a relatively slow speed from the magazine to the tapping position. There, the slide dwells during the operation, after which the trigger action releases it, so that it returns swiftly to the magazine for another nut. This type of intermittent motion is particularly applicable when compact and economical construction are objectives of the designer.

As indicated in the illustration, the mechanism is mounted on the machine frame *H*. It consists of the dovetail slide *A*, on which is guided the auxiliary slide *B*, both slides being actuated by the oscillating segment gear *C*. Gear *C* oscillates at a constant velocity and receives its motion from another member of the machine (not shown). Secured in slide *B* is the round rod *D* which is connected at its left end to the work-carrier (not shown). Spring *E*, which imparts the rapid return movement to the work-carrier, is mounted on rod *D*, and the spring tension is released for the return stroke by the trigger *F*, pivoted on the stationary bracket *G*.

Gear segment *C*, in the position shown in the illustration, has carried both slides to their extreme left-hand position, and in doing so, has caused rod *D* to transfer a nut from the magazine to the tapping position. At this point, trigger *F* has engaged the projection on the auxiliary slide *B*. The gear segment now reverses its movement and carries slide *A* toward the right. During this movement, slide *B* remains stationary, since it is held by the trigger. Near the end of the stroke of slide *A* toward the right, the projection *J* engages the end of the trigger and lifts the latter away from the projection on slide *B*. Consequently, slide *B* is released and under the action of spring *E* is carried toward the right until the rubber bumper *K* comes in contact with projection *J*. Thus, with the return of slide *B*, the work-carrier and rod *D* are returned swiftly to the magazine for another nut. This completes the cycle of the mechanism.



Slide Having a Positive Working Stroke and a Rapid Return Movement

Mechanism for Winding Spherical Cores for Golf Balls

By C. W. HINMAN

Cores for golf balls are produced by winding a soft rubber band on a spherical rubber center. The thin rubber band is approximately 1/16 inch wide and must be wound evenly about the rubber center under uniform tension. The completed core must have a true spherical form. These requirements necessitate a somewhat complicated winding or rotational movement, in order to have the crossing points of the rubber band evenly distributed over the spherical surface of the core, which is constantly increasing in size during the winding operation.

The principal elements of the mechanism that provides the necessary winding movement are shown in Fig. 1. The work is started by placing the rubber center between the four truncated cones or rollers *J*,

mounted in the right- and left-hand winding heads *B*. The rollers are kept in contact with the core by the compressive action of the helical springs *P*, which allow the heads to recede equally as the diameter of the core increases. The bellcranks *V* equalize and centralize the outward movements of the winding heads so that the core is always kept in the central position. The bellcranks are connected with a treadle that permits the operator to withdraw the heads, so that the finished core *W* can be removed. The two ball casters indicated at *N* serve to guide or retain the core in its proper position between the rolls.

The two winding heads *B* have hollow shafts *O*, which are geared to a countershaft (not shown) at the rear of the mechanism. The countershaft is

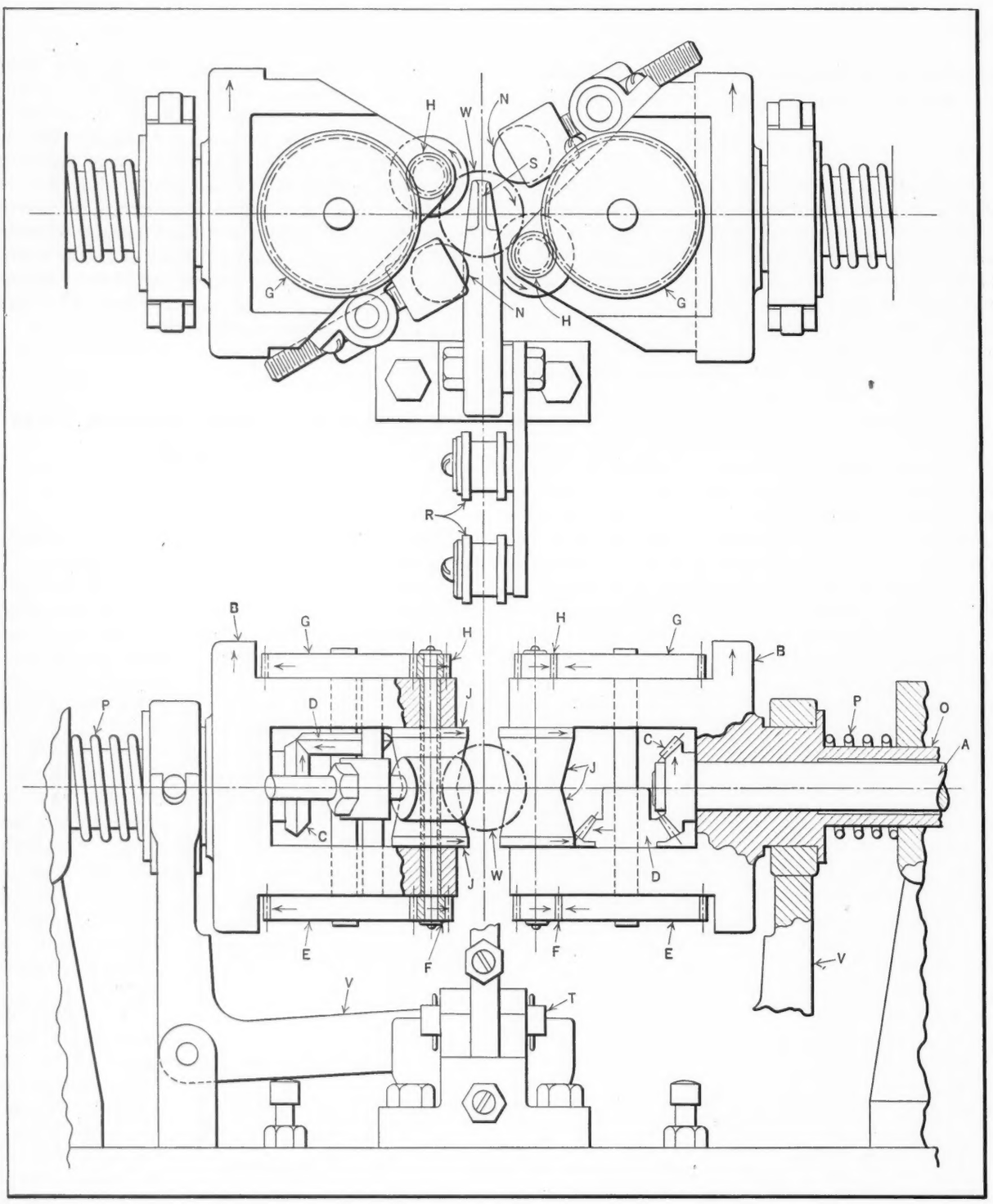


Fig. 1. Mechanism for Winding Thin Rubber Band Evenly over the Surface of a Small Spherical Center of Rubber

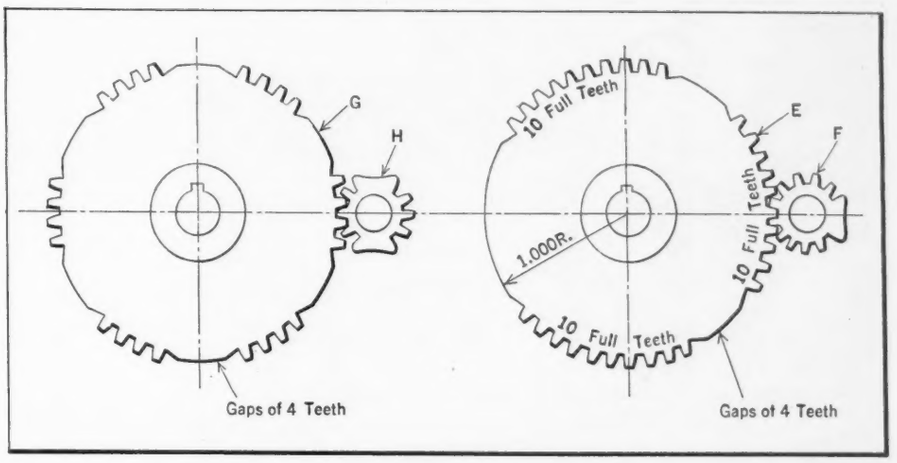


Fig. 2. Intermittent Gears Used on the Winding Heads of the Mechanism Shown in Fig. 1

belt-driven and is provided with a handwheel at one end to allow the mechanism to be operated slowly by hand for making adjustments. The shafts *A*, which run inside shafts *O*, are also geared to the countershaft and run at a somewhat higher speed than shafts *O*. Shafts *A* provide for the secondary revolving movements imparted to the core by the four rollers through the bevel gears *C* and *D*, and the intermittent gears *E*, *F*, *G*, and *H*, plan views of which are shown in Fig. 2. Referring to the lower view, Fig. 1, the shafts of gears *H* drive the two upper rollers *J*, and the shafts of gears *F* drive the lower rollers *J*, mounted on the two opposed heads *B*. Thus different movements are imparted to the upper and lower rolls.

The four rollers have their conical surfaces spotted to give a better frictional grip on the core. The winding operation consists of feeding the rubber band by hand over the first and under the second tensioning rolls *R* and on through the guide slot *S* down on the soft rubber core which revolves rapidly in two directions simultaneously. The feed guide with the tensioning rolls attached swings on a fulcrum pin *T*. A helical spring (not shown) attached to the guide provides the proper winding tension.

The winding movements are obtained from the constant rotation of the heads *B* in the direction indicated by the arrows, combined with the motions imparted to the core by the four rollers *J* driven by the intermittent gears *E*, *F*, *G*, and *H*. These movements are so timed that the rubber band is wound on the rubber core evenly.

When the core reaches the finished size, the machine is stopped automatically through an electrical contact made by the spindle of one of the receding heads. While the approximate winding movements described appear quite simple, the exact path followed by any particular point on the spherical surface of the core is somewhat complicated, as will be apparent when the effect of the difference in speed of the shafts *A* and *O* is considered in conjunction with the rotational movements obtained by the four intermittently rotated rollers *J* and the constant rotational movement of the heads *B*.

Tests Show Superior Wearing Qualities of Nitrogen-Hardened Cast Iron

The results of extensive tests made to determine the practical value of nitrogen-hardening cast iron, to obtain better wear-resisting surfaces, were given in a paper read by J. E. Hurst before the Iron and Steel Institute, Sheffield, England. The tests were made with nitrogen-hardened cast-iron cylinder liners, applied to both stationary and automobile gasoline engines. Direct comparisons were made by employing plain cast-iron cylinder liners and nitrogen-hardened cylinder liners in the same engine, particular care being taken to have the operating conditions the same in all cylinders.

One test run with a six-cylinder car, under typical road conditions, over a distance of 10,000 miles with the engine equipped with both treated and untreated cast-iron cylinder liners gave the following results: Nickel-chromium hardened and tempered cast-iron cylinder liners, 3220 miles per 0.001 inch wear, as compared with 19,020 miles per 0.001 inch wear for nitrogen-hardened cast-iron cylinder liners. This is typical of the results of many similar tests. All the tests clearly demonstrated the improved resistance to wear of cast-iron surfaces hardened by the nitrogen process, when used under the conditions mentioned.

* * *

French Machine Tool Tariff

Our Paris correspondent informs us that the French Government, in order to facilitate importation, is working on an entirely new system regulating the tariff charges on machine tools. Under the present system, because of the Import License Tax, it is impossible to determine in the United States the exact amount of duty on a given entry. It is probable that this Import License Tax, as well as the "quota" system, will be abandoned and a new revised straight tariff rate will be adopted, the actual import duty remaining at approximately the same level as under the present system.

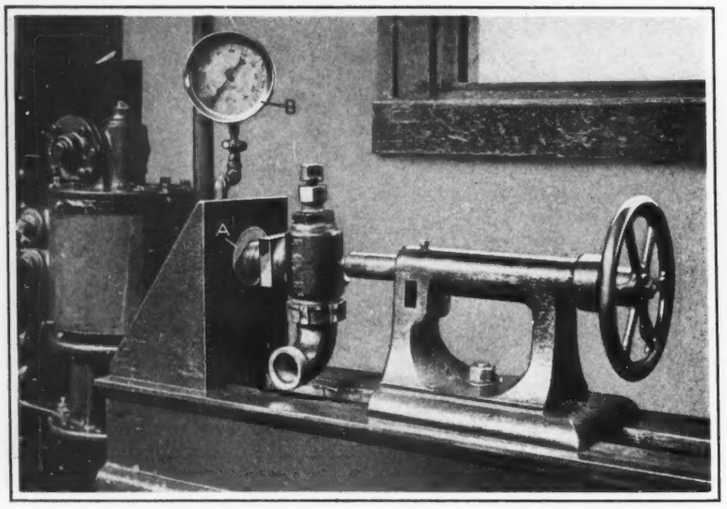


Fig. 1. (Left) Machine Devised for Testing Valves of Various Types under a Water Pressure up to 350 Pounds per Square Inch

Fig. 2. (Below) Changes Made in an Old Air Compressor to Adapt it for Service on Equipment Shown in Fig. 1

Testing Valves for Leakage

By HERBERT OLIVER

Equipment constructed in the Stratford, Ontario, shops of the Canadian National Railways for testing valves hydrostatically is shown in the accompanying illustrations. As will be seen, it consists essentially of the steam end of a scrapped air compressor, an old lathe bed, a tailstock, and an angle-plate.

In use, one orifice of the valve under test is clamped tight against leather gasket *A*, Fig. 1, by exerting pressure through the tailstock center. Water is then forced into the valve through a 3/8-inch hole in the center of the gasket by applying pressure through the air compressor. Defects in the valves are revealed by water passing the valve gate or disk. For valves of a different design from that shown in Fig. 1, the tailstock arbor can be equipped with a leather-faced flange, 6 inches in diameter. The pressure on the valve at any time during a test is indicated by gage *B*. Pressures up to 350 pounds per square inch are used; a safety valve is provided to insure that the maximum pressure will not be exceeded.

Fig. 2 shows the changes made in the air compressor to adapt it for this service. The changes consist merely of adding cylinder *C*, piston *D*, and a piston-rod *E* of increased length. Water is supplied to the lower end of cylinder *C* from a supply tank. When air is applied to push the piston down, this water is forced out of the cylinder under pressure through a 1/2-inch pipe *F* to the machine and into the valve being tested. The left-hand end of pipe *F* is connected to the water supply tank.

Fig. 4 shows the opposite end of pipe *F*. It is connected to a 3/8-inch copper pipe, as shown, which leads to the hole in the leather gasket against which the valves are clamped for testing. Gage *B* is also connected to this pipe line. The relief valve is mounted on the end of pipe *F*, as indicated at *G*. At the end of a test, cock *H* is opened to allow water in the gage pipe to drain into pan *J*, from

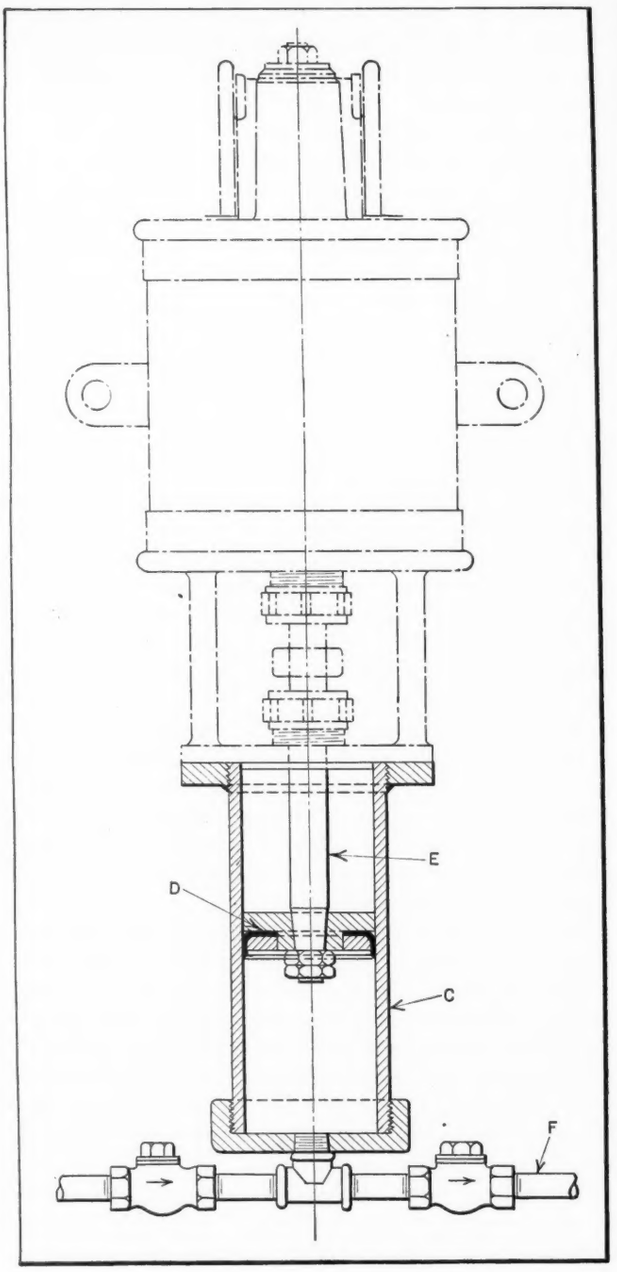
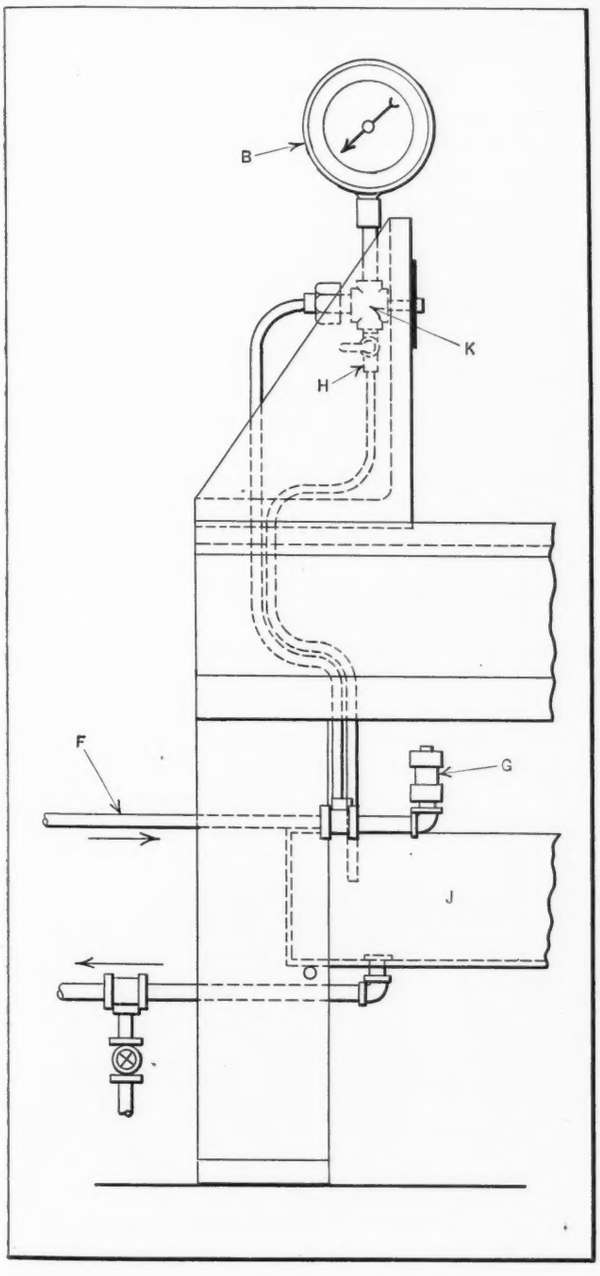
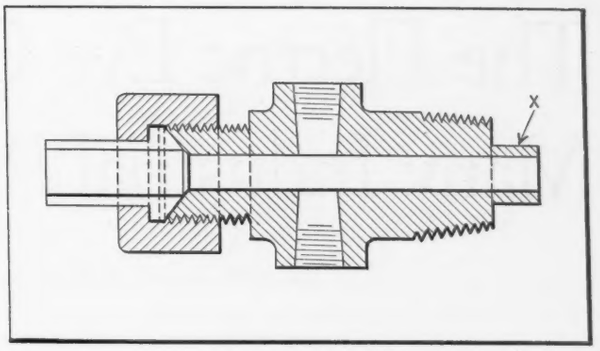


Fig. 3. (Right) Cross-sectional View Showing Details of the Fitting Indicated at K in the Illustration Fig. 4

Fig. 4. (Below) View Showing the Arrangement of the Piping on the Valve Testing Machine Illustrated in Fig. 1





which it runs through a pipe back to the water supply tank or to a drain, as desired.

Fig. 3 shows a detail of fitting *K*. The leather gasket, to which the valve under test is clamped, fits on boss *X*, which, of course, projects through the angle-plate.

* * *

A Suggestion for Machining Fiber

A solution of one of the problems that have puzzled many turret lathe operators is given by C. S. Stilwell, sales manager of the Warner & Swasey Co., Cleveland, Ohio. A demonstrator of the company was doing some work in the machine shop of a nationally known concern and found that the best operators had been unable to cut a clean thread on some fiber parts. A die-head was used, but the thread would break or chip, and the job would not pass inspection. Other operators tried the job. The chasers were reground and a variety of lubricants were tried.

The solution came when one inquiring operator found that the fiber was stored in the stock-room way up by the ceiling, and became, as a result, very dry. By putting the material out of doors overnight, so that it would gather moisture, it was found that perfect threads could be cut. The overnight seasoning did the trick.

* * *

Exports of Industrial Machinery Increase

The export field is beginning to offer worth-while opportunities, in the opinion of Robert E. W. Harrison, chief of the Machinery and Agricultural Implements Division of the Bureau of Foreign and Domestic Commerce. Exports of industrial machinery dropped to a low point—slightly under $3,300,000—in May, 1933, but have steadily climbed since that time until somewhat over $8,000,000 was reached in March of this year. This uniform upward tendency is in marked contrast with the "spotty" condition of domestic business during the same period, and points clearly to the desirability of increased activity on the part of machinery exporters.

The Electric Eye Controls Many Industrial Processes

A Number of Examples of the Industrial Application of the Photo-electric Cell, Indicating a Few of Its Varied Uses

By JOHN ALLEN MURPHY

THE photo-electric cell traces its origin to certain properties of the chemical element selenium. Back in the seventies it was discovered, quite accidentally, that selenium changes its electrical resistance when subjected to varying intensities of light. For a long time this discovery had only an academic interest, but after a while, efforts were made to utilize this peculiar property of selenium to operate electric control devices. Thus the first photo-electric cell came into existence.

Three types of cells have been developed. The first was the photo-conductive cell, in which a change in electrical resistance is caused by exposure to light. Selenium was the basis of most cells in this class. The difficulty with this type was that it was too easily influenced by uncontrollable conditions. It was not reliable, and, hence was unsatisfactory for commercial use.

Next came the vacuum-tube type of photo-electric cell, which is reliable and is in extensive use today. One of its shortcomings is that for many applications it requires too much auxiliary apparatus, and its operation often requires too much supervision. Despite this, it is the best cell to use for many purposes.

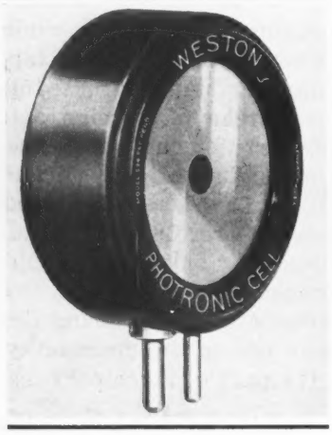
The Latest Type—The Photronic Electric Cell

The photronic electric cell is the third type. It consists simply of a small disk of metal on which is laid a very thin layer of a sensitive material, the composition of which has not been revealed by its makers. The disk is really a miniature power plant, as it converts light energy into electrical energy. Just why and how it does this is not definitely known even to the engineers who developed it. There is no satisfactory scientific explanation of the phenomenon. The principal advantage of the photronic cell is that it does not require nearly so much supplementary apparatus as the vacuum-tube type, nor the subsequent replacement attention; yet, it is just as reliable.

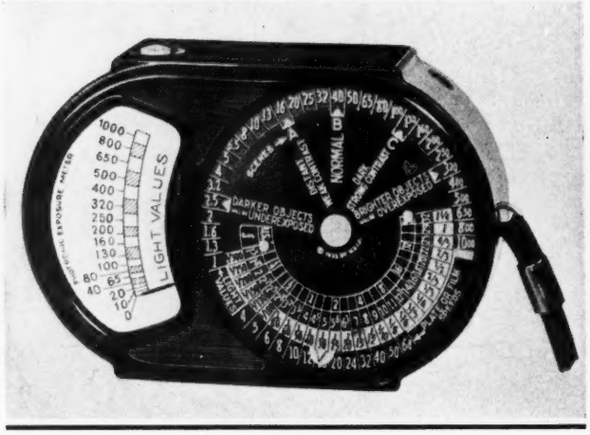
Just as the discovery of the properties of selenium started the experiments that finally led to the present photo-electric cell, so the present cell has, itself, arrived at the stage of development that suggests new ideas in the design of industrial equipment that can be controlled by it, since the work performed by this cell is principally of a control nature. The cell puts a beam of light to work to perform a thousand and one different control operations. To discharge these operations properly, the cell usually has to be designed into the apparatus, mechanism, or machine for which it is to be used. In many cases, entirely new mechanisms have been created to make the performance of the required job possible.

Applications of the Photo-Electric Cell

Many of the applications of the photo-electric cell are well known. The turning on and off of street lights, the operation of airplane beacons, the opening and closing of doors, the control of boiler firing, and the sounding of an alarm when fumes in tunnels or mines become menacing are familiar uses of the cell; but that this device has become an integral part of many machines, and that new mechanisms are being created to make possible the extension of



(Left) One Type of Photronic Electric Cell. (Right) Length of Exposures Ranging from 1/800 Second to 8 Minutes is Measured by the Weston Exposure Meter, which Uses a Photronic Cell to Accurately Gage the Light Conditions



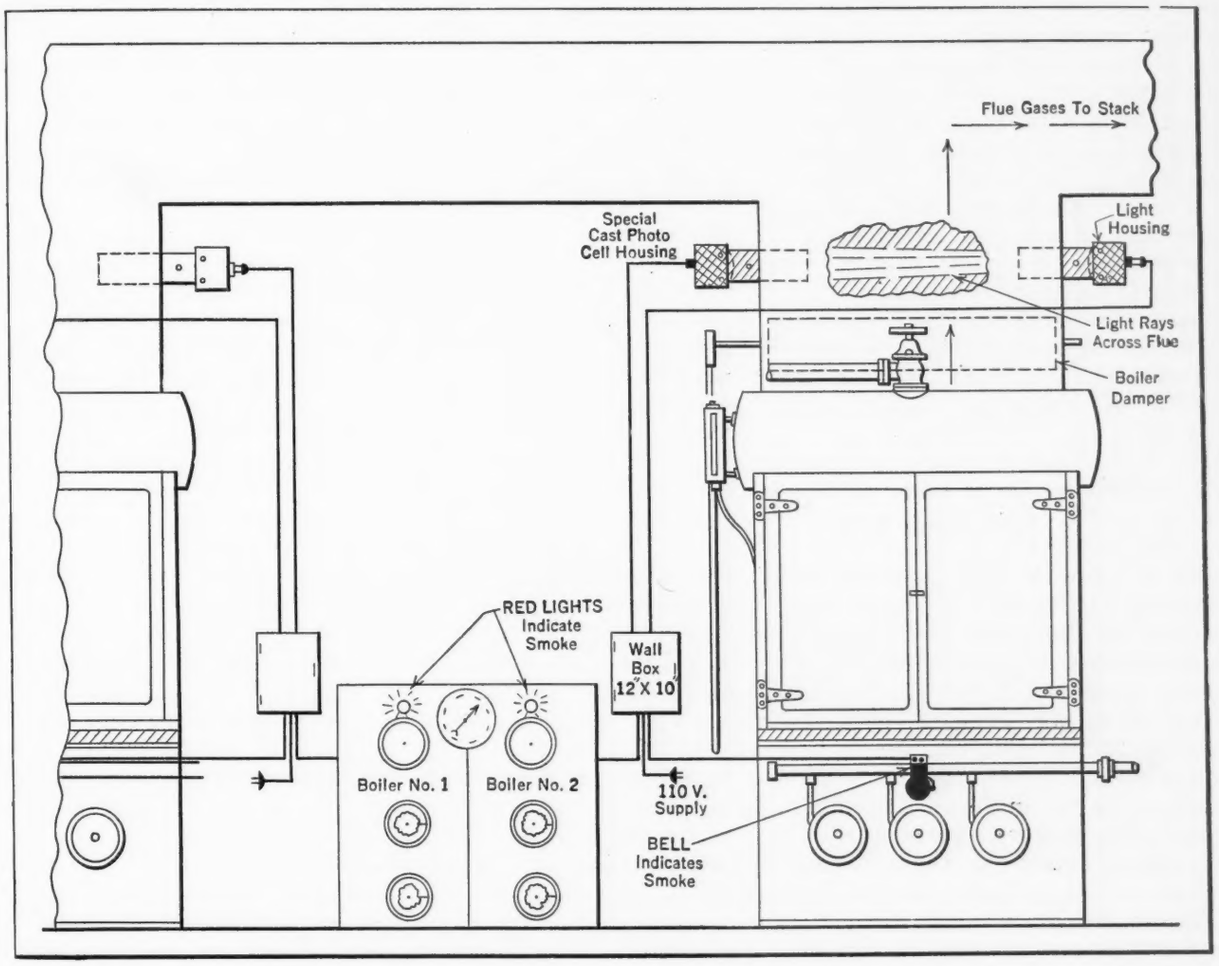
the use of the cell into almost every industrial field, is not so well known.

Weighing is one of these new fields. Many weighing operations are being handled by photo-electric cells, particularly of the photronic type. At first these applications were engineered for each job; but the experimental stage is gradually being passed, and right now, at least one manufacturer of scales is building the photronic cell into some of his designs.

Counting is another important application. The photo-electric cell can make an accurate count of the bottles of milk or the packages coming from a machine, of the number of patrons entering a theater, or the number of automobiles crossing a bridge or going through a tunnel. After these uses have become reasonably standardized, manufacturers of counting and packaging machinery will doubtless make the photo-electric cell an integral part of their machines.

A recently developed use of the cell is for stopping the flow of oil into an oil-burning boiler in case the fire goes out, so as to prevent any possible danger from an explosion when the flame resumes. This particular installation is most unusual. In nearly all photo-electric cell operations, the source of light is an electric lamp. In the present instance, however, the ray of light that operates the photronic cell comes from the flame in the boiler. The cell is housed immediately outside the wall of the boiler. The pipe on which it is mounted leads into the boiler, and the light from the fire which operates the cell passes through this pipe.

If the fire goes out, the light fails. The cell operates a sensitive relay, which, in turn, actuates a power relay and thus causes the blower motor to be shut down, closing the electrically operated oil-valve. Hence, there is no danger of oil accumulating in the burner, with the possibility of an explosion. All this takes place in a fraction of the time that it takes to tell about it. This application has proved so successful that it is likely that photo-electric cells will be included as part of fuel-burning equipment. Already manufacturers of thermostatic control devices are studying the possibilities of adapting the photo-electric cells to their lines.



Diagrammatic View Showing the Application of a Photo-electric Cell as a Smoke Indicator in a Boiler Installation

The control of color in production is another promising application. As an example may be mentioned the use of the electric eye in the pearl-button industry. The demand is for a white button.

A considerable percentage of the buttons coming from a production machine run to yellow and other off shades that cannot be sold as first quality. The white buttons have to be separated from those of other colors. In the past, this separation has been done by hand, but recently a machine has been developed in which was incorporated an electric eye which tosses out the off-color buttons. The machine does this work more economically and accurately than it can be done by the aid of the human eye. In roasting coffee, photronic cells have been installed to indicate exactly when the coffee is brown enough. Here the cell is an integral part of the coffee-roasting machinery. In the candy business, the uniform color of chocolate can be regulated in the same manner. The photo-electric cell is also being applied for obtaining uniform color in gasoline and lubricating oils in the petroleum-refinery business.

For determining the shade of colors with scientific exactness, an ingenious instrument has been devised known as the "color comparator." This instrument compares the color being inspected with some previously fixed standard color. Variations of this instrument are employed in several industries to watch production and to sound an alarm when the color of the article is off more than a predetermined amount.

The Opacity of Paper is Checked by Photronic Cells

In paper mills, the photo-electric cell has many applications. Opacity must be considered in the making of paper and tracing cloth, and also in many textiles. A satisfactory tracing cloth has an opacity of about 45 per cent. High-grade transparent cloth may have an opacity of 20 per cent. The opacity of most commercial papers runs between 50 and 90 per cent. It is difficult, however, to maintain the uniformity of this opacity. Photronic-cell-controlled apparatus is being used to an increasing extent to regulate this troublesome matter.

The moving-picture industry is today the largest user of the new amazing electric eye. The reproduction of good talkies is altogether dependent on sound and light synchronization, which is made possible by the photo-electric cell.

In taking ordinary pictures, experience has shown that even the most expert photographers are liable to guess at the light quality, and sometimes guess badly. A device known as the Weston exposure meter has been brought out to deal with this difficulty. By the use of photronic cells, it is possible to accurately gage the light conditions and to determine the length of exposures ranging from 1/800 second to 8 minutes.

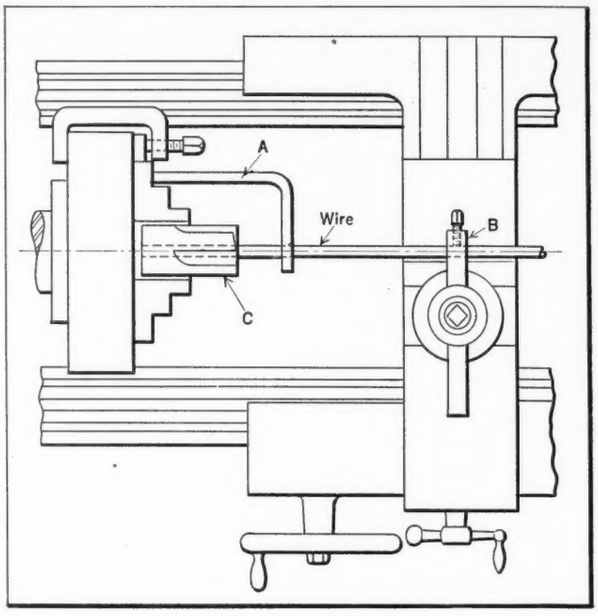
The examples mentioned indicate the tremendous variety of uses for which photo-electric cells are adapted; yet their application is still in its infancy. The possibilities of simplified control by this new device appear to be limitless.

Lathe Set-Up for Reducing Size of Wire or Rod

By PETER L. BUDWITZ

Occasionally there is a demand for pins of a special size that must be made from the wire or rod stock on hand. By the aid of a few simple tools, a lathe can be used to reduce long pieces of such material to the desired size. The material thus reduced in size can then be cut up into pieces of the required length. The accompanying illustration shows a plan view of a lathe set-up for reducing wire to a specified size.

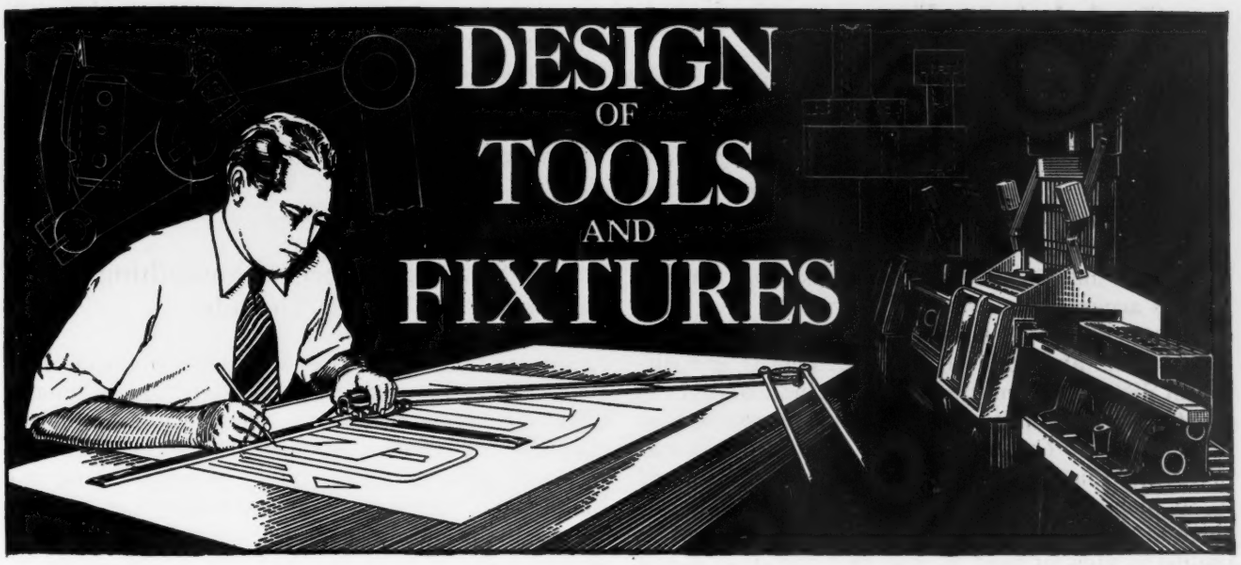
The equipment consists of the guide *A*, the wire-holder *B*, and a hollow mill *C*. The wire guide is bent to shape from a flat piece of steel and is clamped to the lathe chuck which holds the hollow mill. The wire-holder *B* is merely a flat piece of steel, which is clamped in the toolpost of the lathe. Near the end of the piece a hole is drilled to receive the wire and a set-screw is provided to clamp it.



Method of Using Hollow Mill in Lathe to Reduce Wire or Rod to Special Size

In operation, the wire is run through the wire-holder and guide up to the hollow mill. The wire-holder is then brought back a safe distance from the guide and the wire fastened by tightening the set-screw.

When the lathe is started and the feed set in motion, the holder feeds the wire through the hollow mill. As the holder nears the guide, the set-screw holding the wire is loosened and the holder returned to the starting point. The wire is again clamped and the procedure repeated until the entire length of the wire is reduced to the required size. The hole through the lathe spindle forms the outlet for the finished wire.



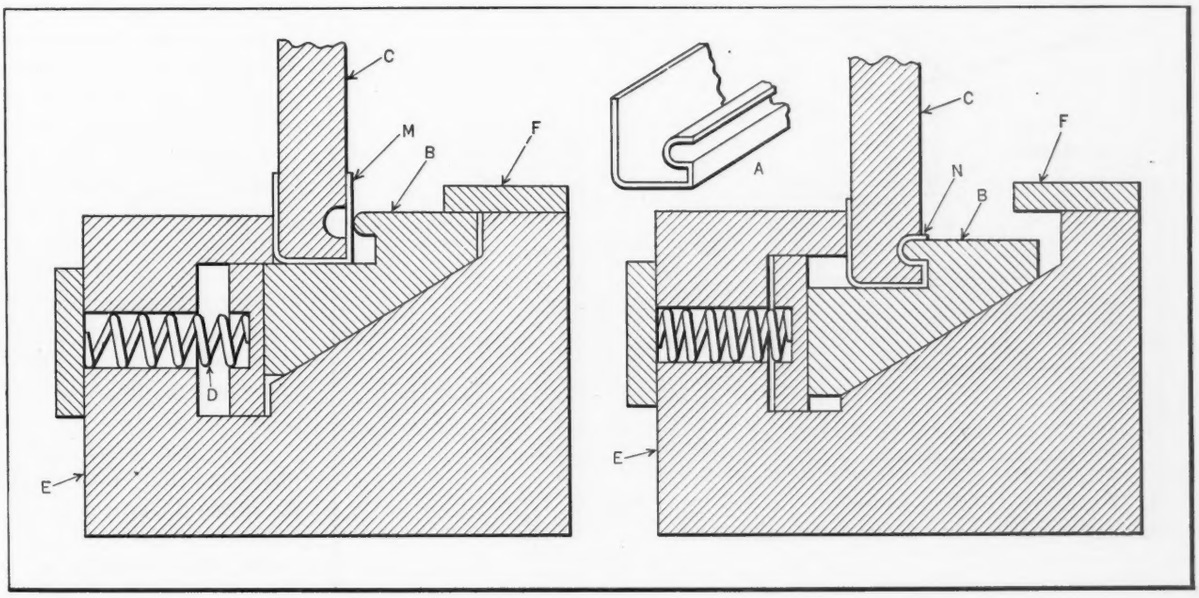
Die for Forming Channel-Shaped Clip

By L. KASPER, Philadelphia, Pa.

The accompanying illustration shows two sectional views of a die designed to form the light brass clip *A*. The stock is placed on the face of the die against the stop *F* and the descending punch first forms it into the channel shape shown at *M*. Further movement of the punch *C* causes the block *B* to recede into the block *E*. As block *B* descends, it moves to the left, because of the angular surfaces between blocks *B* and *E*, until the forming of the work *A* is completed, as at *N*.

The movement of block *B* is resisted by a series of springs *D*, the resistance being sufficient to prevent movement of block *B* until the first forming operation is completed, as at *M*. On the return stroke of the ram, block *B* moves upward and to the right, and the work is carried out of the die on the punch *C*, from which it is stripped by a hand-operated ejector.

The ejector consists of a rod that is slidably mounted in a bracket secured to the bolster plate. This rod is so located that it will pass under the punch *C* when the ram is at the top of its stroke, but will strike the work *A* when it is pushed forward, stripping the work from the punch. A wooden knob on the end of the rod provides a convenient striking surface for the operator's hand, and a spring returns the rod to its normal position, so that it will clear the punch on the down stroke.



Cross-sections of Punch and Die Used in Production of 3-inch Lengths of Channel-shaped Pieces A

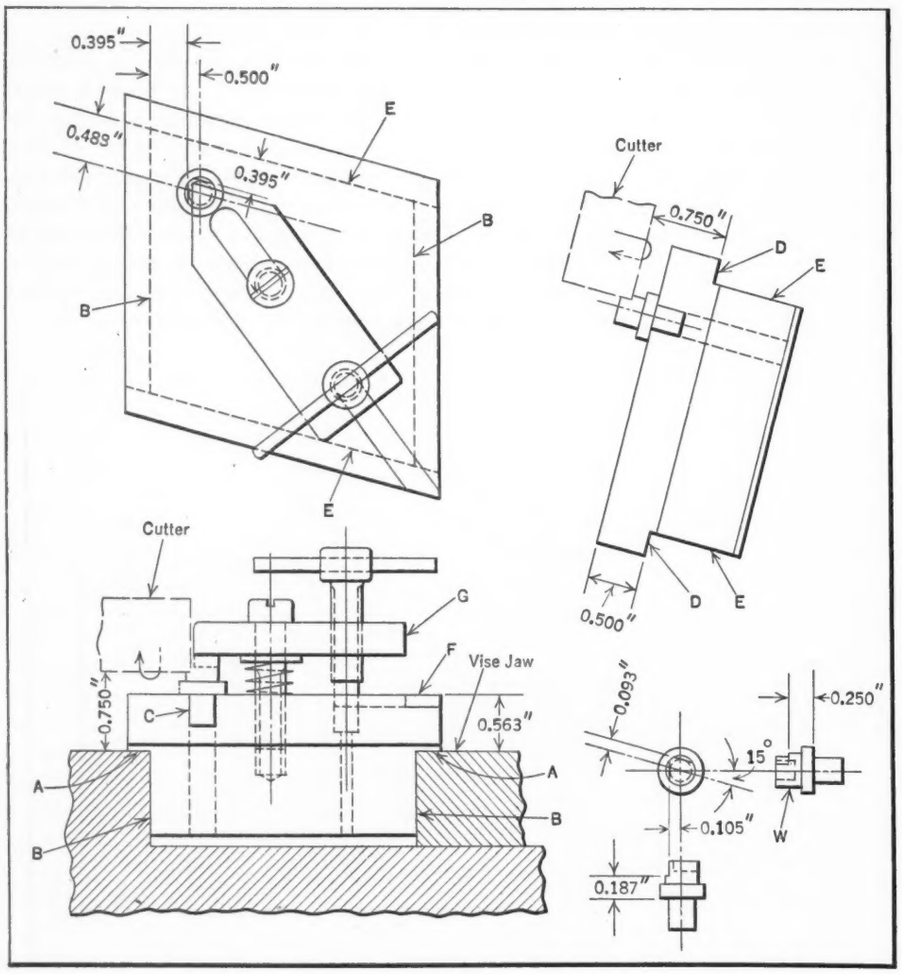
Simple Indexing Fixture for Use in Milling Machine Vise

By C. COLE, Dayton, Ohio

When production requirements make it inadvisable to build an expensive indexing fixture, the one shown in the illustration will serve as a good substitute. Although a little slower than the regular type, this indexing fixture produces work that is just as accurate.

The part *W* to be milled is a stud with two flats milled at an angle and at different depths and different distances from the center, as indicated in the illustration. The fixture is composed of a steel base *F* and a clamp *G*. In designing the fixture, it was necessary that the dimensions, such as 0.395 and 0.750 inch, be calculated to permit machining the sides of the work to suit the dimensions given in the detail view of part *W*, and that the sides *B* and *E* be machined to correspond with the angle shown on the detail of the part.

In use, the fixture is first set on a milling machine vise, the shelves *A* resting on top of the vise jaws, with the sides *B* clamped between them. The work is placed in the hole *C* and held by clamp *G*. The first cut is then taken, after which the vise is unclamped and the fixture turned around, so that the shelves *D* rest on top of the vise. The fixture is held in this position for taking the second cut by clamping the sides *E* between the vise jaws.



Fixture for Milling Flats on Stud Head, Designed to be Indexed by Changing Position in Vise

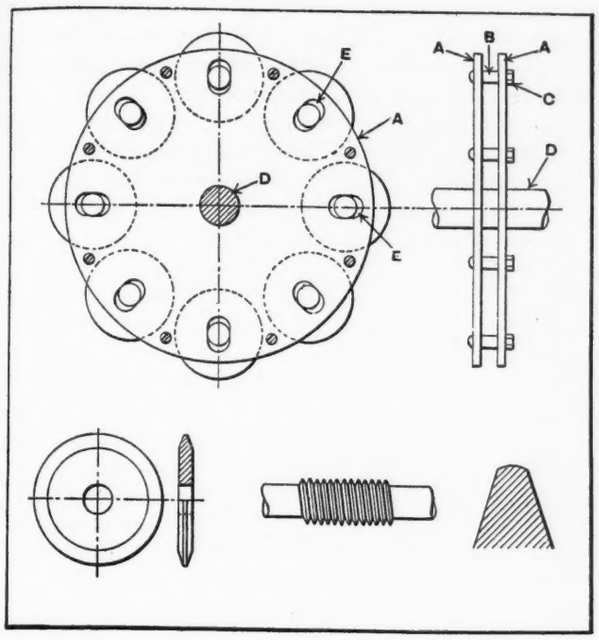
Swaging Wheel for Smoothing Worm Threads

Smooth and quiet operation are essential features of worms used in the construction of phonographs, dial telephones, etc. To meet these requirements, the worm thread must have a glass-like and flawless surface. In one plant manufacturing the instruments mentioned, various methods of lapping were tried to obtain the required surface, but without success. Finally the swaging wheel shown in the illustration was tried out and was found to give satisfactory results. The wheel is rotated at a high speed, and is secured to the shaft of a motor, which is mounted either on the lathe or the screw machine used in the operation.

Eight small hardened disks, beveled to conform with the worm thread, are confined between the flanges of the wheel and are free to rotate with respect to the wheel. Radial movement of these disks is also provided for by elongating the flange holes in which the disk shafts turn.

In operation, the rotating wheel is fed toward the work until the bevels on the disks come in contact with the sides and bottom of the worm thread. A slight additional feeding movement will now cause each disk, as it passes the worm, to strike the thread surfaces, resulting in a series of rapid hammer blows that gradually peen down all the high spots on the sides of the thread, leaving a glass-like surface.

The use of a coolant for this job is advisable. It should, however, contain very little oil; otherwise, the rotation of the disks will be hampered. Various other uses for this device may suggest



Wheel which Swages or Smooths the Surface of Worm Threads through the Hammering Action of Small Hardened Disks

themselves. The writer has also found it very satisfactory for burnishing flat surfaces, although it is much slower in operation than a surface grinder. If a surface has been damaged, it can be readily repaired by means of the wheel shown, with the advantage that practically no metal is removed in the operation. B. R.

Tool for Cutting Internal Grooves

By P. F. ROSSMANN, Detroit, Mich.

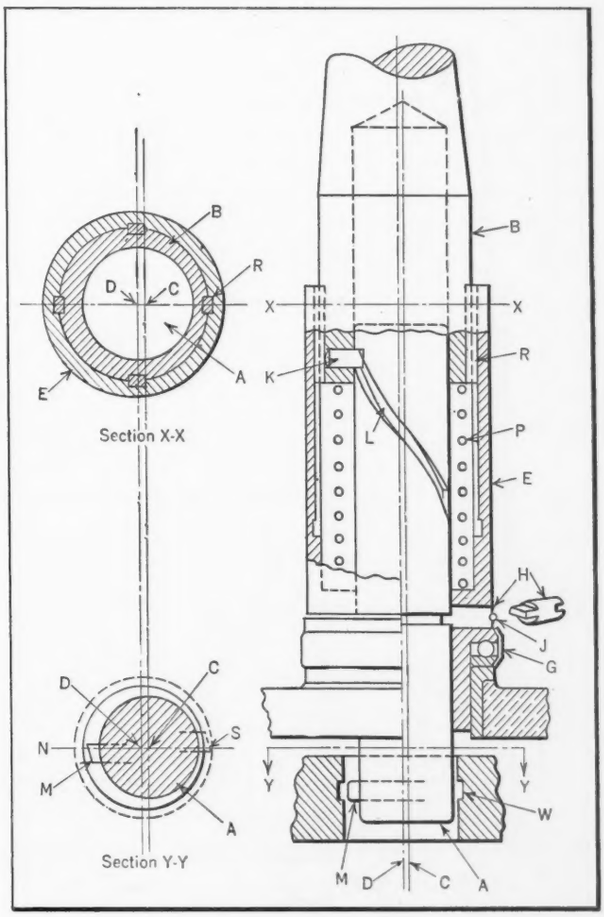
The groove-cutting tool or bar shown in the accompanying illustration is operated in a manner similar to a spot facing or drilling tool when cutting the groove *W*. That is, the rotating spindle is simply fed downward to a stop and then returned to the starting point. The spindle *A* is located eccentrically in the main drive bar *B* on center line *C*, line *D* being the center line of bar *B* and the groove *W* to be cut.

The outward feeding movement imparted to cutter *M* is obtained by rotating spindle *A* on its eccentrically positioned center line or axis *C*, so that the cutter is carried from *N* to *S*, section *Y–Y*. The rotation of spindle *A* in bar *B*, required for the feeding movement, is produced by the spiral groove *L* in spindle *A*. Sleeve *E* is fitted with a thrust bearing *G* and is located on spindle *A* by key *H*, which has a tongue that fits into a groove in spindle *A*.

Key *H* is retained by a wire ring *J*. Keys *R* on bar *B* are a sliding fit in slots in sleeve *E*, so that the eccentrically located holes in bar *B* and sleeve *E* are kept in alignment. The spring *P*, acting against the end of bar *B*, tends to force sleeve *E* and bar *B* apart, but is prevented from doing so by the pin *K* fixed to bar *B*. This pin projects into the helical groove *L*. In the illustration, pin *K* is shown in contact with the upper end of groove *L*, where it prevents further movement of sleeve *E* on bar *B* and also serves to locate cutter *M* at position *N*, section *Y–Y*. When the bar *B* is fed downward, spring *P* is compressed and spindle *A* is caused to rotate in bar *B* by the cam action of pin *K* in slot *L*. This rotary motion is continued until cutter *M*, section *Y–Y*, is rotated from position *N* to *S*, where it is stopped by pin *K* coming in contact with the lower end of slot *L*.

When the tool is in use, sleeve *E* enters the holding fixture bushing until bearing *G* strikes the bushing that locates cutter *M* vertically. Continued downward movement of bar *B* serves to compress spring *P* and rotate spindle *A* within bar *B*, as previously described, so that the cutter is fed outward to finish groove *W* to the required depth.

When the tool is withdrawn, spring *P* serves to retain the location of cutter *M* vertically until it has rotated back to position *N*, after which the entire assembly is withdrawn.



Tool Used in Drilling Machine Spindle for Cutting Recess W

Fixture for Making Two Opposite-Hand Bends Edgewise in Flat Stock

By EDWARD HELLER, Cleveland, Ohio

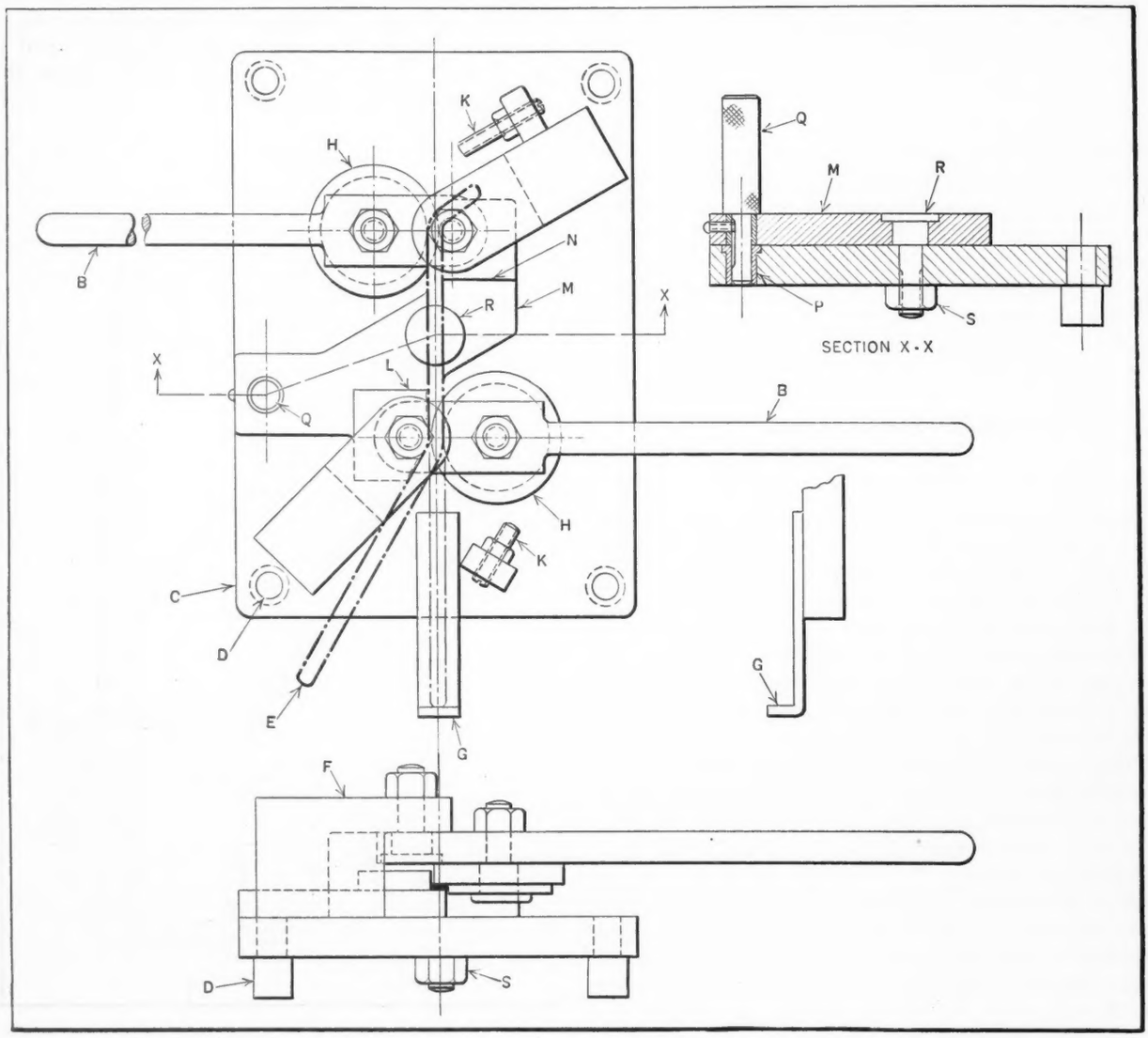
The accompanying illustration shows a bending fixture for forming half-hard cold-rolled steel bars edgewise to the shape shown by the heavy dot-and-dash lines at *E*. These bars have a developed length of 13 9/16 inches and are 0.095 inch thick by 3/8 inch wide.

The bending fixture consists primarily of a form-carrier *M* having two forms *L* and *N* securely fastened to it, two roll-carriers *B* with rolls *H*, and two overhanging brackets *F* with pivot bearings for the roll-carriers.

The pivoting pins of the roll-carriers are located at the centers about which the bends are made. The short end of the bar is bent to an angle of 70 degrees about a radius of 1/4 inch, while the long end is bent back to an angle of about 27 degrees on a radius of 1/2 inch. When the fixture is ready to receive the work, the levers *B* are in the position shown in the illustration. The bar to be bent is slipped in from the top and pushed down until the lower end is in contact with stop *G*.

The levers are then turned in a clockwise direction until they come up against adjustable stops *K*. This completes the bending operation, but the bar is wrapped around the forms and, of course, cannot be removed until the form-carrier is pivoted on the fulcrum stud *R*. The pin *Q* is therefore pulled up so that it clears the bushing *P* and the carrier *M* is rotated to the right away from the rolls, thus releasing the formed bar.

After the bar has been removed, the carrier is swung back into place and locked with the pin *Q*, making the fixture ready to receive the next bar to be bent. The various parts of the fixture are mounted on a piece of boiler plate *C*, which is raised above the bench on feet *D* so that it clears the nut *S* on the pivot stud *R*. Best results are obtained by fastening the fixture to a bench or other flat surface located at a convenient height.



Fixture for Bending Cold-rolled Flat Bar Edgewise to the Shape Shown by the Dot-and-dash Lines at E

New Type Cutting Tools Demand Less Vibration in Machines

By EVERETT CHAPMAN, Vice-President in Charge of Engineering
Lukenweld, Inc., Coatesville, Pa.

IT is well known in the mechanical field that cemented-carbide cutting tools, because of their structural characteristics, should not be subjected to excessive vibration. These tools are composed of a matrix in which the finely divided carbides are embedded. While the matrix, in itself, possesses good physical strength, its structure is broken up by the finely divided carbide particles. Hence, the physical strength of the cemented-carbide cutting tool is not so great as that of a cutting tool composed of a homogeneous material.

Vibration in a machine tool bed imposes a rapid series of small impacts on the cutting tool. This frequently causes breakage of cemented-carbide tools and shows the necessity for stiffness in machine tools.

We hear of means provided for absorbing vibration; but if the vibration is prevented from occurring, there will obviously be no need of absorbing it. There are two ways of increasing the stiffness of a machine tool bed: First, material of a high modulus of elasticity should be employed; second, theoretically ideal sections to prevent vibration should be selected. This points to the use of steel for machine beds whenever possible, as a substitute for cast iron, because of its higher modulus of elasticity and the opportunity in welded-steel structures to make the steel sections and the construction such as to meet the requirements for any given load.

Machine tool loads are highly indeterminate. The magnitudes and directions of the tool loads cannot be readily ascertained. The ideal section for resisting such loads is a closed section—box or tubular. Sections of this kind are difficult to produce in cast iron, because of the complicated core work. In welded steel, they are very simple. The designer, therefore, through the use of closed welded sections can effect a gain in stiffness with the same amount of material that may run as high as from 200 to 300 per cent. Owing to the higher modulus of elasticity of steel, he makes a gain of 250 per cent. The total gain can be used to effect a reduction in weight, combined with improved qualities in the bed structure.

The flexibility of the welded-steel method of fabrication makes it possible for the builder of machine tools to obtain sliding surfaces integral with the bed having a hardness of 530 Brinell. Lathe beds are being built today, the main section of which is a closed box of low-carbon steel, with ways that are welded integral with the bed and are made from a steel that can be hardened. A process is in use that, after the welded bed has been completed and heat-treated, will harden each sliding surface to a depth of 3/16 inch and to a hardness of 530 Brinell.

An experimental welded-steel lathe bed has been in service for more than two years. Compared with the former lathe bed, it weighs 30 per cent less, its stiffness is 200 per cent greater, and up to the present time, it has shown no evidence of distortion.

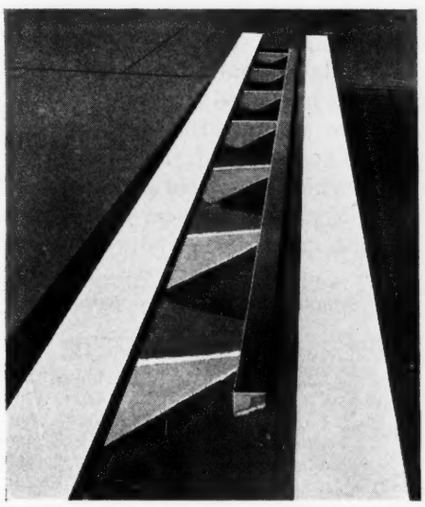


Fig. 1. (Left) Welded-steel Bed for a 60-inch Engine Lathe. Note the Diagonal Stiffeners which Form the Sides of Chip-disposal Chutes along the Rear of the Bed

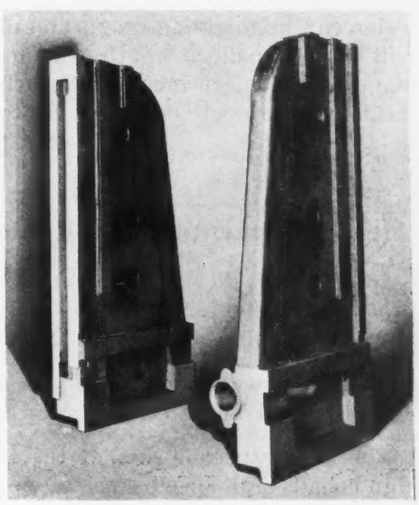


Fig. 2. (Right) Housing for a 48-inch by 48-inch by 18-foot Planer Made from Welded-steel Construction. The Housings Weigh 6340 Pounds. The Cast Housings Formerly Used Weighed 7330 Pounds

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

G. A. E.—What kind of cutting lubricant should I use to obtain a fine finish in form-turning hard rubber?

A.—Good results have been obtained in some cases by using a sulphonated type of soluble oil. It was found that with a 10 to 1 mixture of water and this type of soluble oil, an excellent finish could be obtained on hard rubber parts. No trouble has been experienced with gumming of the tools or gibs. This solution has also been used successfully for grinding, threading, and other machining operations on both hard rubber and synthetic plastics.

Low-Temperature Carburizing

J. M. D.—What is the process known as "low-temperature carburizing"?

A.—It is believed that the process to which you refer is known as the Salerni process for low-temperature carburization, which is being developed in Sheffield, England. The rights to this process have been acquired by Neanthracite, Ltd., Sheffield, England.

Welding Magnesium Alloys

L. B.—Can magnesium alloys be welded successfully, and if so, what methods should be used?

A.—Magnesium alloys can be welded either by the oxy-acetylene or the electric spot or seam welding process. Several commercial aluminum welding fluxes have been developed, composed essentially of sodium, potassium, and lithium chlorides. Acetylene welds can be made on magnesium-alloy sheets that will have a tensile strength of from 25,000 to 30,000 pounds per square inch. Satisfactory electric spot welds can be made on sheets up to 1/4 inch thick.

Heat-Treatment of Cobalt High-Speed Steel

G. M.—I would like to obtain information on the heat-treatment of cobalt steel tools, especially for use in machining automobile crankshafts.

Answered by Owen K. Parmiter
Firth-Sterling Steel Co., McKeesport, Pa.

The writer presumes that the inquiry refers to high-cobalt high-speed steel of approximately the following composition: Carbon, 0.78 per cent; tungsten, 18.5 per cent; chromium, 4.5 per cent; vanadium, 1.75 per cent; molybdenum, 1.0 per cent; and cobalt, 9.0 per cent.

Forged tools made of this steel must be annealed before hardening. Before applying the full hardening heat, preheating is necessary. The work should be heated thoroughly at about 1500 degrees F. before being transferred to the high heat for hardening. As this type of steel has a tendency to decarburize if held too long at or above the preheating temperature, it is sometimes advisable, especially with large tools, to apply a double preheat. The first preheat is applied at about 1250 and the second at 1550 degrees F.

When the work has been thoroughly preheated, it is transferred to the high-heat furnace, where it is quickly brought to the hardening heat, which is from 2400 to 2450 degrees F. Prolonged soaking should be avoided, as this tends to cause decarburization and grain growth. The cooling may be done in an air blast, in oil, or in a fused salt bath. For lathe tools not subject to shock, oil-quenching is recommended. The temperature of the oil-quenched tools should not be allowed to drop below 200 degrees F., and the work should be tempered or drawn immediately.

The drawing operation is very important. The temperature of the drawing bath or oven should never be over 400 degrees F. when the tools are introduced. For lathe tools where maximum hardness is required, a drawing heat of 975 degrees F. is recommended. The work should be held at this temperature for about two hours after being soaked through. If increased toughness is desired, as in the case of a tool with considerable overhang, a second draw at 650 degrees F. is recommended.

Owing to the unusually high hardening heat required for high-cobalt high-speed steel, tools made from it should be roughly ground after forging and annealing. After being hardened, the work should be carefully ground to remove the decarburized surface completely. The strain of the severe cutting conditions under which this steel generally operates makes it necessary that the clearance angles be less than those used on other high-speed steels.

As a general guide, the following temperatures for high-cobalt high-speed steel may be given:

Operation	Temperature Range, Degrees F.
Forging	2100 to 1650
Annealing	1600 to 1700
Preheating	1450 to 1500
Hardening	2400 to 2450
First Draw	975 to 1050
Second Draw	600 to 700

Airplane Engine Plant Uses Carbide Tools in Small-Lot Production

It Has Been Found Advantageous to Use Tungsten-Carbide Tools for Finishing Highly Accurate Parts at the Plant of the Wright Aeronautical Corporation, Paterson, N. J.

By FREEMAN C. DUSTON

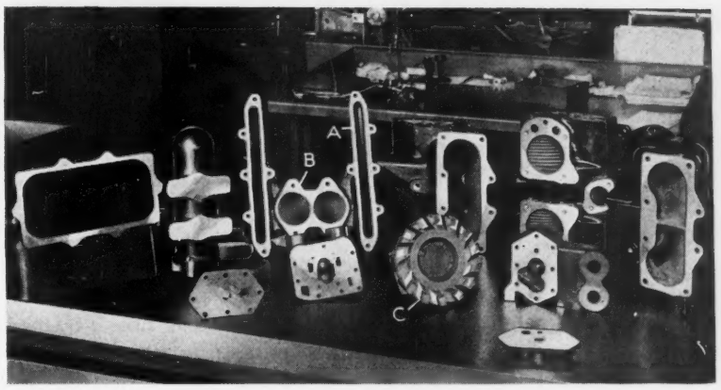
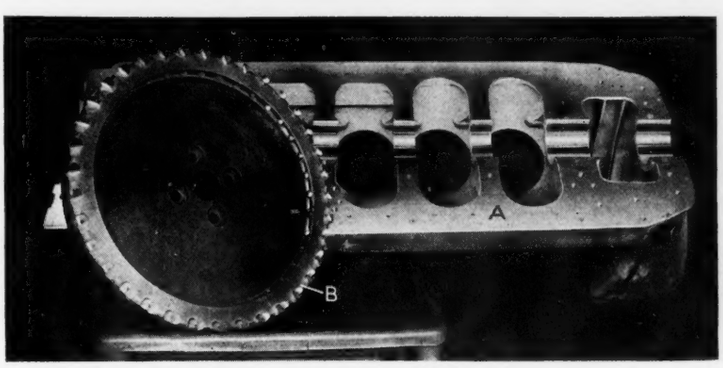


Fig. 1. The Flat Surfaces on this Group of Ten Airplane Engine Parts are all Milled Accurately and with a Fine Finish by the Inserted-tooth Tungsten-carbide Cutter C

SINCE the introduction of tungsten carbide as a cutting material in 1928, interest has been centered primarily upon its application to quantity-production work. The uses of tungsten carbide in this field have been recorded in numerous articles in MACHINERY and the new development has been followed closely by the entire machine-building industry. While much has been written about the high-production records made by this cutting material, its use for machine parts made in small lots has received little attention. This is due largely to the impression that tungsten carbide can be used economically only when employed on parts produced in large quantities.

That tungsten-carbide tools and cutters can be used advantageously in machining small-lot work where high precision rather than high production is the principal requirement has been demonstrated at the plant of the Wright Aeronautical Corporation in Paterson, N. J. In this plant, accuracy forms the foundation on which the reputation of the well-known line of Wright airplane engines rests; and, since airplane engines are built in small lots only, the reason for employing tungsten-carbide cutting tools is not merely to be able to use higher cutting speeds but to produce the finer finish obtainable with the higher speeds, or, in some instances, to make possible the use of improved materials that could not be employed in the past, because they could not be machined with the available cutting tools.

Fig. 2. An Exceptionally Fine Finish is Obtained on the Flat Surface A of the Crankcases for Curtiss Conqueror Engines with the 18-inch Lovejoy Cutter B, which has 36 Carboloy-tipped Teeth



Although low cost was not the determining factor in adopting tungsten-carbide tools for the applications referred to in this article, the practice of machining a number of different parts with one tungsten-carbide milling cutter, as is done successfully at the Wright plant, holds possibilities that may have far-reaching effects in other machine-building plants. The first cost of tools is not the only cost. The fact that tungsten-carbide tools will machine many times the number of pieces between grinds, as compared with former cutting tools, has a tendency to offset the element of first cost.

Where small lots are handled, it is conceivable that the use of tungsten-carbide tools might well be considered in designing similar parts, with the object of bringing as many pieces as

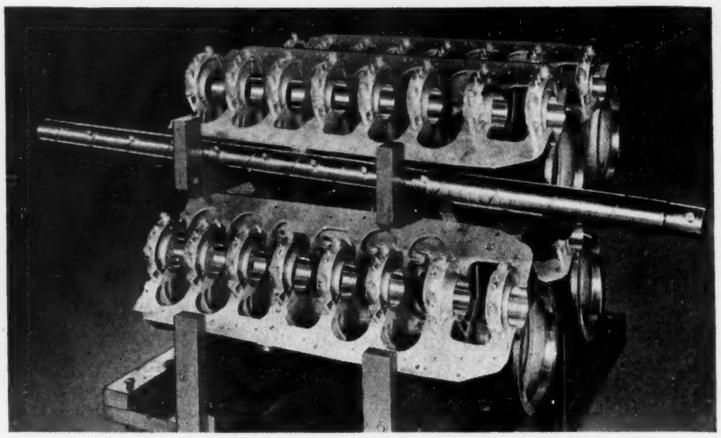


Fig. 3. This Illustration, Reproduced from an Unretouched Photograph, Indicates the Exceptionally Fine Finish Obtained on Crankcase Bearings by Finish-boring with Tungsten-carbide Tools

practicable within the machining range of a single tool or cutter. In many cases, a standard milling cutter can be selected that will be suitable for machining several different parts. Ten parts machined with one cutter are illustrated in Fig. 1.

Types of Tungsten-Carbide Tools and Cutters Employed on Small-Lot Production

Tungsten-carbide tools are now used in ten departments at the Wright plant. These tools include milling cutters of various designs, reamers, boring tools, hollow mills, form-turning tools, turning, chamfering, and facing tools, and line-boring bars. These applications indicate the wide range of small-lot high-precision work now performed by tungsten-carbide tools. The majority of applications consist of precision finishing operations on aluminum forgings and castings, using Carboloy tools and cutters.

Milling operations are performed by cutters ranging in size from 18-inch face mills to small hollow mills. Fig. 2 shows the finish-milled face *A* of a crankcase made from an aluminum alloy, and the cutter *B* used for the milling operation. The cutter has thirty-six inserted teeth tipped with Carboloy. The principal advantage in using tungsten carbide on this job is the exceptionally fine finish obtained. The milled surface has the appearance of a fine grinding job.

About 200 of these crankcases are finished before regrinding the cutters. Before using tungsten carbide, only 6 crankcases could be machined per grind. Cutting speeds have also been increased from 50 to 122 revolutions per minute. The same 18-inch cutter used for the crankcase is used for two water jackets of the same material.

Fig. 4 shows a 10-inch Lovejoy cutter used in finishing a cylinder block. Here the cutter is operated at a speed of about 400 revolutions per minute, with a feed of 8 inches per minute.

The 6 1/4-inch Kearney & Trecker cutter *C* in Fig. 1 is employed for finishing operations on ten different parts. This cutter is large enough to take the required cuts on the various pieces, its diameter being limited by the largest size that will pass between the projecting lugs of piece *A* when machining surface *B*.

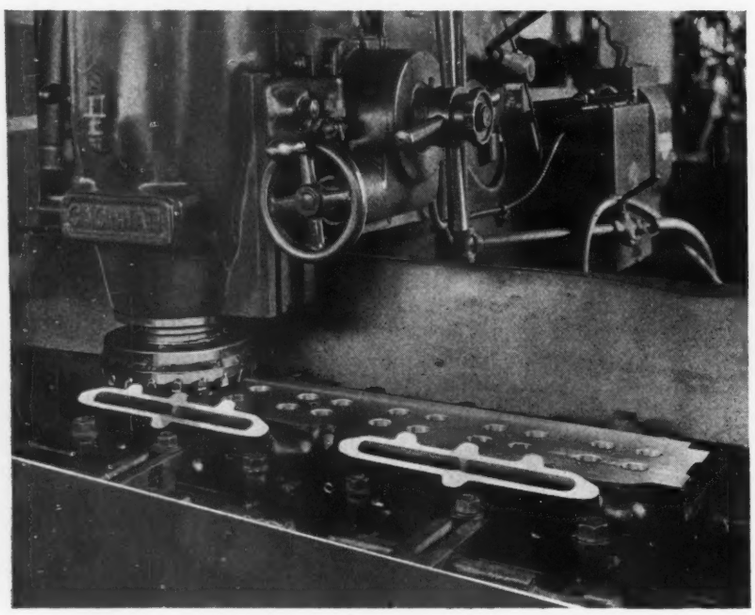


Fig. 4. The 10-inch Lovejoy Cutter here Illustrated has Tungsten-carbide-tipped Teeth and is Run at a Speed of 400 Revolutions per Minute with a Feed of 8 Inches per Minute in Milling the Cylinder Block Shown

An Instance where Tungsten Carbide Solved a Difficult Problem

Counterboring spark-plug-cooler recesses in the cylinder head of an air-cooled engine, as illustrated in Fig. 5, is one of the difficult machining problems solved by the application of tungsten carbide. The thin cooling fins of this tough aluminum casting present an unusual problem. In order to cut the fins without distorting them, it is necessary to run the cutter with a fine feed and at very high speed. With ordinary cutting materials, this would dull the cutting edges very quickly. The tungsten-carbide blades of the counterbore not only give the machined surfaces of the fins a smooth finish without distorting them, but continue to maintain their cutting edges after a long period of use.

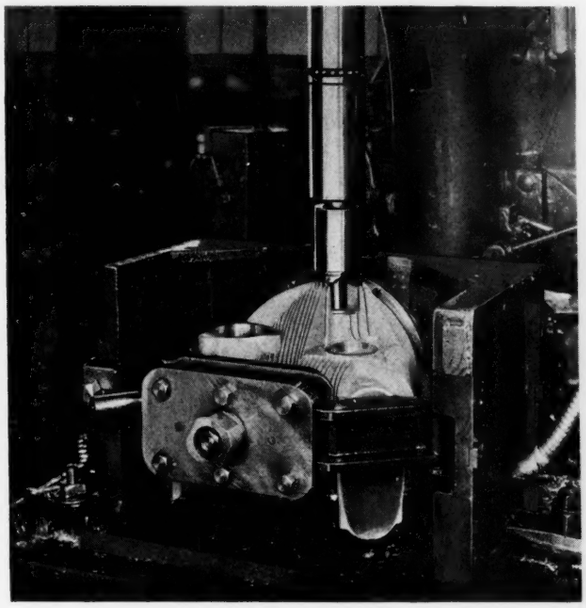


Fig. 5. Counterboring the Air-cooled Cylinder Head without Distorting the Thin Cooling Fins is Accomplished by Using a Tungsten-carbide Tool

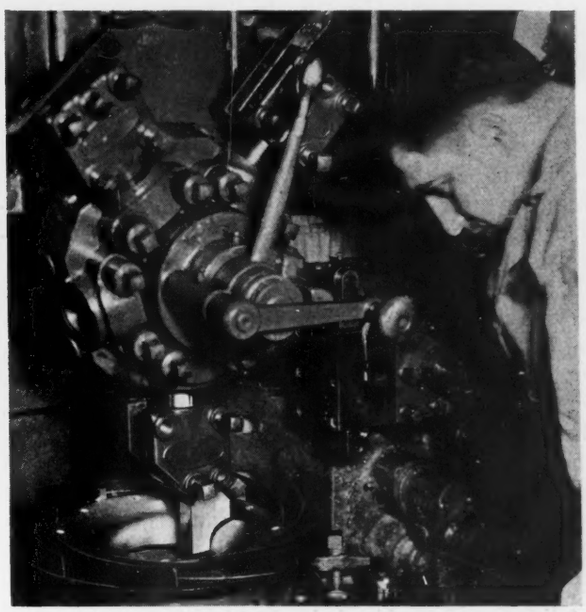
The main crankshaft bearings of Curtiss Conqueror engines shown in Fig. 3 are finish-bored on a W. F. & John Barnes Co.'s boring machine. The unretouched photograph from which this illustration was reproduced indicates the exceptionally high finish obtained on these bearings. In fact, the finished surfaces have the appearance of accurately ground surfaces.

After rough-boring the eight bearings with a special boring-bar equipped with high-speed steel tools, the boring-bars are changed and the finishing cuts taken with tungsten-carbide tools. After this finish-boring operation has been completed, steel-backed Kelmet bearings are inserted and a third boring-bar equipped with tungsten-carbide tools is employed to finish-bore these inserted liners.

The valve guide holes in Curtiss Conqueror cylinders are reamed very accurately to size with piloted reamers having tungsten-carbide inserts. A piloted reamer of this type will ream twenty-five cylinder heads without regrinding, as compared with eight heads per grind for the tools previously employed. The high speed at which the tungsten-carbide reamers are operated gives the holes an exceptionally fine finish. The total tolerance on these holes is 0.0005 inch.

In one department a battery of twelve Bullard boring machines engaged in machining aluminum alloy castings and forgings that have been heat-treated are equipped with tungsten-carbide tools wherever a high finish is required. The work handled in this department includes front and rear sections and diffuser plates for the radial type air-cooled engines.

Fig. 6. Forming the 16-inch Opening in a Diffuser Plate to a Radius of 1 1/4 Inches with a Flat Forming Tool Faced with Tungsten Carbide



One notable example of the application of tungsten carbide in this department is the form-turning or boring of the 16-inch diameter opening in a diffuser plate, as illustrated in Fig. 6. The flat forming tool faced with tungsten carbide is formed to a radius of 1 1/4 inches. The turning speed on this job is two and one-half or three times that used with tools previously employed. This high cutting speed produces a finished surface that has the appearance of being polished.

The semi-finishing operations on piston-pin holes

in forged aluminum pistons are performed on a diamond-boring machine using tungsten carbide. The final finishing operation is performed with diamond tools. The work in this case is run at very high speeds, using a coolant.

Tungsten-carbide tools are also employed in finishing the piston-ring grooves in aluminum pistons. Five grooves are machined at a time. A straight in-feed or plunge cut is used for this work.

Tungsten-carbide single-point tools are employed on a Coulter diamond-boring machine for rough-boring both the large and small ends of connecting-rods for Curtiss Conqueror engines. The steel-backed Kelmet bearing at the large end of the connecting-rod is finish-bored with a diamond tool after rough-boring with the tungsten-carbide tool. The bronze bushing in the small end of the rod is rough- and finish-bored in the same way.

Buying Machine Tools Table d'Hote or a la Carte

The ideas expressed in the article "Buying Machine Tools Table d'Hote or a la Carte" in May MACHINERY have merit and point toward an ideal situation, but I doubt if it can be attained.

The problem of fixing responsibility for breakdowns is a complex one. Our experience, gained during a period of seventeen years, has proved that over 75 per cent of the requests for service were due directly to acts of the user or could have been taken care of without asking for assistance. Yet it is difficult to convince the user that this is so. He is a purchaser, and, therefore, has a big stick to wield. Of course, there are exceptions, and I could name a number of firms who will do everything in their power to take care of their own difficulties before asking for service from the manufacturer.

I do not believe that the user who demands little service is paying a large premium. It is true that the builder tries to get service costs into his price, but it is seldom that he is able to get compensation in that way for excessive demands for service. Machine tool prices are not high enough for that. The result is that on machines sold to the user who does not demand free service, the builder obtains a reasonable profit; whereas, when the user asks for an excessive amount of service, the builder obtains no profit and sometimes meets with a loss.

I would like to see the problem solved on the basis that all service would be paid for after a certain length of time had elapsed from the delivery date of the machine.

NORMAN D. MACLEOD, President
Abrasive Machine Tool Co., East Providence, R. I.

I agree thoroughly with the ideas expressed in the article written by a prominent mechanical executive in the automotive industry on the subject of production guarantees, free demonstrations, and service, as published in May MACHINERY. I would like very much to see a plan such as he suggests adopted. It would be an excellent thing if the buyers of machine tools and the machine tool industry could agree on a plan of this kind, because, as the author of the article referred to states, the firm that does not require free service certainly helps to pay for the unlimited service that some less efficient organization asks for. It is especially significant that this suggestion comes from a man in the automotive field with such wide experience as this mechanical executive apparently has had.

CALDWELL R. ROSBOROUGH, President
Moline Tool Co., Moline, Ill.

For a period of time I was responsible for machine tool purchases in one of the large automotive plants, and for the last fifteen years I have been in the machine tool business.

Without question, the present system of selling machine tools should be revised. The first step would seem to be a segregation of the elements in estimates. First, the standard machine or part of a machine should be a listed item or known cost factor; next, the cost of special devices should be a separate estimate; then there should be added an item for what might be called the element of risk; and finally, a suitable sum should be allowed for guaranteeing production. The customer can then determine whether he wishes to absorb the element of risk or the factor of guaranteed production.

Some plan of this kind would go a long way toward preventing unfair practices where some buyers demand an excessive amount of service. There has been a considerable tendency in the last few years on the part of mechanical executives in machine tool using plants to lean heavily on the machine tool builder. The responsibility should be more equitably divided.

C. B. DEVLIEG, President
DeVlieg Milling Machine Co., Jackson, Mich.

* * *

Unusual interest in arc welding throughout the world is evidenced by a statement issued by the Lincoln Electric Co., Cleveland, Ohio, who informs us that, in a single day, orders were received from thirteen different countries for the book "Procedure Handbook of Arc-Welding Design and Practice."

Formula for Width of Stock Required for Multiple Circular Blanking

By E. R. JOHNSON
Revere Copper & Brass, Inc., Chicago, Ill.

In producing circular blanks from strip stock with multiple punches, the least amount of stock will be wasted in the form of scrap if the blanks are arranged in a line at an angle of 60 degrees with the edge of the stock, as shown in the accompanying diagram. This produces a staggered arrangement in which the centers of any group of three adjacent blanks are located at the corners of an equilateral triangle.

In estimating the cost of a blanking job of this kind, it is common practice first to determine the blank size and then make a full-size lay-out on paper, grouping the blank circles to save as much stock as possible. The bridge or metal width between the circles is predetermined according to the thickness, temper, material, etc., of the stock to be blanked. In order to eliminate this time-consuming process, the writer evolved the formula given in this article, which permits the width of stock required to be determined by simple calculation, without the necessity of making a lay-out. This formula has proved to be a great time-saver and should be found useful in the engineering department and tool-room as well as in the estimating department.

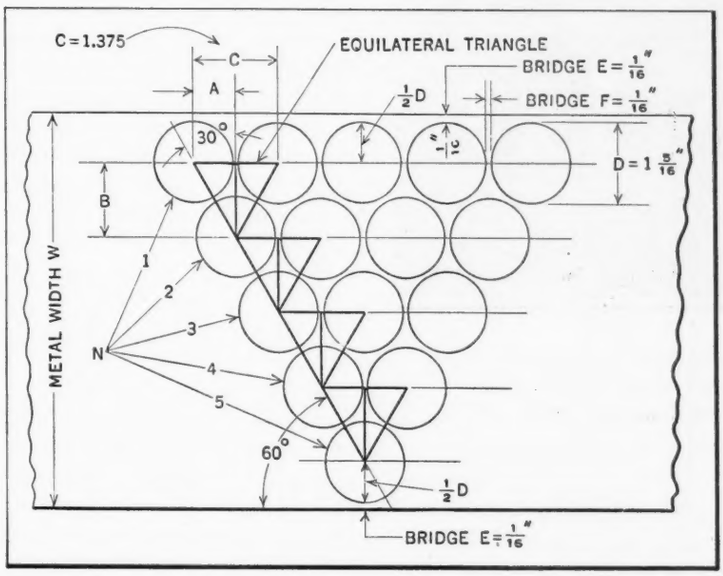


Diagram Illustrating the Use of a Simple Formula for Finding Width of Stock Required for Multiple Circular Blanking

The formula for finding the width of stock W required when the blank diameter and number of punches to be used have been determined is as follows:

$$W = 1/2C \times \cot 30 \text{ degrees} \times (N - 1) + D + (2 \times E)$$

in which

D = blank diameter;

E = distance between edge of strip and blanks;

F = distance between adjacent blanks;

C = distance between centers of adjacent blanks; (This is equal to the width of the bridge F plus the diameter of the blanks.)

N = number of blanks arranged on the diagonal line at 60 degrees with the edge of the strip stock.

Substituting the numerical values given in the accompanying diagram in the preceding formula, we have:

$$W = 0.6875 \times 1.7320 \times 4 + 1.3125 + 2 \times 0.0625 = 6.200 \text{ inches}$$

The derivation of the formula is comparatively simple, the constant 1.7320 being the cotangent of 30 degrees, which is used to obtain the length B. The length B is equal to the altitude of the equilateral triangle and forms one side of a 30-degree right-angle triangle.

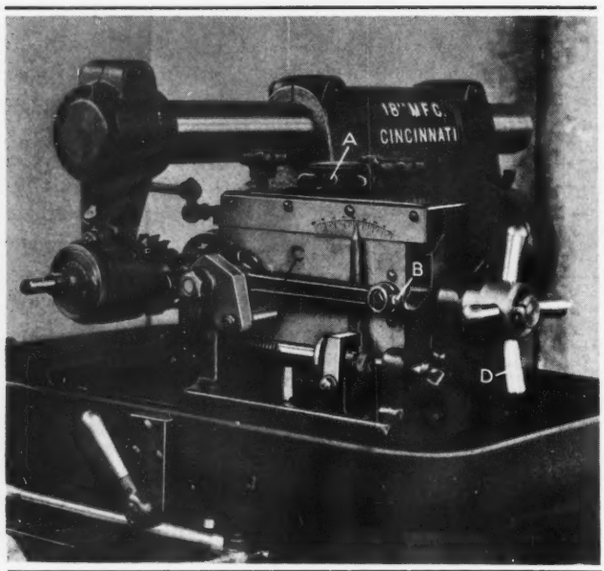
Referring to the diagram, it will be seen that B equals the vertical center-to-center distance between the circular blanks, while the side A is equal to one-half the horizontal center-to-center distance. Thus we have B equal to the cotangent of 30 degrees $\times$ A. After obtaining B it is simply a matter of multiplying this distance by the number of blanks on the diagonal line minus 1, and adding twice the radius of the blank and twice the width of the bridge or space between the edge of the stock and the blank.

* * *

Fuse costs and the time lost in productive work due to blown fuses are often overlooked, because the maintenance department of a plant accepts such costs as necessary. Since the development of fuseless circuit-breakers, however, some shop engineers have been analyzing the cost of circuit protection. In a large steel mill, it was found that the average cost of replacing fuses was over $7500 a year. Another analysis in the machine shop of the Railway and Industrial Engineering Co., Greensburg, Pa. (as recorded by the Westinghouse Electric & Mfg. Co.) revealed an actual cost of $3224 annually, due to blown fuses. This shop has a connected load of 500 horsepower, with sixty motors ranging from 1/4 to 50 horsepower driving machine tools. Some of the machines are driven by individual motors, and others are driven by motors in groups of from two to six.

Milling Balancing Bosses on Eighty Connecting-Rods an Hour

Forged-steel connecting-rods like the one shown at *C* in the accompanying illustration must be accurately balanced. Also, the difference in weight between any two finished rods must not exceed two grams. The connecting-rod forgings are made with



Milling Machine with Special Cam-operated Table and Adjustable Fixture for Milling Balancing Boss on Connecting-rods

cylindrical bosses or lugs at each end from which metal is removed in the final machining operations in order to balance the rods properly and bring them to the required weight. The rod *C* is shown mounted on a fixture in a Cincinnati milling machine, ready for the milling operation on the boss at the large end of the rod. The boss milled in this case is the same as the one shown at *A* on the connecting-rod resting on top of the fixture.

The boss *B* at the small end of the rod is milled on another machine in a similar manner, the work being fed across an end-mill. One operator attends both machines and also weighs both ends of the assembled rods at a production rate of eighty complete rods an hour. The preliminary operations performed on the rods and caps include broaching the joint face and half-bore and bolting them together, as well as drilling and reaming the piston-pin hole in the rods.

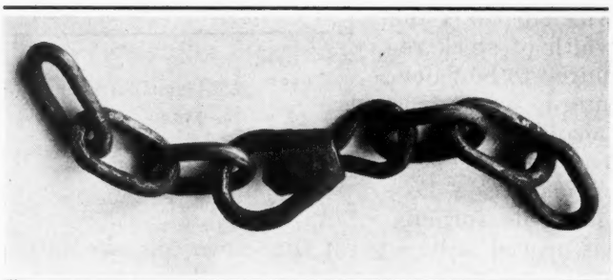
In milling the boss at the large end of the connecting-rod, the work is located on two studs fixed in the adjustable slide of the fixture, as shown. The adjustable slide is moved forward or backward, by means of the handwheel *D*, to a position corresponding to the amount of metal to be removed, as determined by a weighing scale upon which the work is placed prior to this operation. The work is fed to the cutter, returned, and stopped in one complete cycle by means of a barrel cam, worm, and worm-wheel arrangement which replaces the conventional table feed, spiral gear, and rack mechanism. The cam-feed arrangement insures accuracy in setting the point at which the movement of the table is reversed.

The needle that points to the graduated arc is mounted on a fulcrum pin on the base of the fixture, and is operated by means of a spool rod and spring-actuated finger which makes contact with the boss to be milled. The needle indicates the position of the boss relative to the point at which the table reverses after taking the cut. In other words, the needle indicates the amount of metal to be removed. Adjustment can be made to compensate for cutter wear by means of the thumb-screw on the spool rod. The dial or graduated arc is so calibrated as to indicate the number of grams of metal to be removed from the boss. When this is recorded, the stop-finger is moved out of the way by turning the small star-wheel. The work is then traversed rapidly forward to the cutting position. After completing the cut, the work is returned by a rapid movement to the starting position, where the table is automatically stopped.

* * *

An Example of Copper Welding

The ancient art of welding copper is supposed to have been lost, but James Cran of Plainfield, N. J., who rose to artistic fame some twenty-five years ago because of the roses, thistles, and other objects



Forged and Welded Copper Turnbuckle and Chain Links

that he forged from solid iron, believes differently. The illustration shows a copper turnbuckle and several links of a copper chain forged and welded by Mr. Cran, using an ordinary blacksmith's forge. Tests made on the chain indicate that the welds are of approximately the same strength as the solid metal in the links.

It is true that there are only a few instances where copper welding may be required, but apparently it can be done.

The Shop Executive and His Problems

Superintendents and Managers are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

SOME time ago I read in the news: "National Recovery Administrator Hugh S. Johnson issued an order empowering the Plant Extension Subcommittee of the Cotton Textile Industry Committee to examine into the application for, and to issue, certain certificates for the installation of additional productive machinery by members of that industry." In my opinion, this simple statement provides an immense amount of food for thought.

Our country has created the highest standard of living in the entire world through the freedom of manufacturers and individuals to exercise their own judgment in regard to the use of equipment and machinery to facilitate production and raise living standards. I, for one, believe that we are proceeding along the wrong road when the installation of machinery becomes a matter of permission obtained through a governmental agency; and if we are proceeding along the wrong road, let us all have courage enough to say that we think so—let us admit that a mistake has been made. ENGINEER

Who Pays for Wasteful Methods?

While it is true that no increased manufacturing capacity is desirable so long as an industry cannot work to anywhere nearly the capacity of its present facilities, low-cost manufacturing is not only desirable, but necessary, if we are to improve our condition and get out of the present difficulties. It is just as wasteful to manufacture a product at a cost 10 or 15 per cent greater than necessary as it would be to take good materials of the same value and dump them into the sea.

The fact that men are being paid wages to produce in a wasteful manner does not help the situation. If the manufacturer is losing money because of wasteful production methods, this is a national loss, and ultimately everyone will suffer because of it—not the manufacturer alone. There will be less produced—less to share and to enjoy. That fact cannot be emphasized too often or too definitely.

Whoever continues to use wasteful methods in manufacturing is to that extent injuring not only his own business but the entire recovery program. On the other hand, whoever adopts new methods for manufacturing or producing things at less cost, benefits not only himself but the nation as a whole.

With the present conditions of wages and working hours imposed upon industry, it is an absolute necessity that manufacturing methods be so improved that the ultimate cost of manufacture is not increased by the higher wage cost. If it is, higher wages are of no benefit, because the higher wage would not buy any more than the lower wage did before. I wish that the Government would preach this doctrine through its excellent channels of publicity, instead of the doctrine of reduced production, which ultimately will result in lowering the standard of living. G. R.

Safety Inspection for New Equipment

When new industrial equipment is installed, it is usually somebody's job to see that it is properly guarded before it is allowed to be used. Seldom, however, is the internal assembly checked for safety of operation. It is nearly always taken for granted that this was attended to by the manufacturer of the machine before he allowed it to leave the factory.

Sometimes, however, the manufacturer neglects to take this precaution or relies on a superficial check, especially in cases where itemized and explicitly written inspection instructions are not used. Assumptions of this kind are dangerous and may result in fatal accidents, as they did in the factory of an eastern manufacturing company.

From the safety standpoint, it is always wise and desirable to have all new equipment inspected internally as well as externally before it is used. The case of the company referred to illustrates this point. A new machine was purchased which arrived completely assembled and wired for connection to a heavy heating current at 10,000 volts across the terminals. The factory electricians made the necessary electrical connections after the mechanical installation was completed, but did not notice that the internal wiring was faulty. A "dead" lead proved to be alive, and as a result an operator was electrocuted.

Manufacturers of electrically operated equipment invariably furnish connection or wiring diagrams, and if these are referred to in checking installations, accidents such as the one mentioned will never occur. The prevailing tendency in matters of safety, however, still seems to be to assume that the "other fellow" has done his work and has done it correctly. JAMES J. BAULE

Meeting Today's Problems of Industry

Quotations from an Address by Herman H. Lind, General Manager of the National Machine Tool Builders' Association, before the Spring Convention

ONLY the best of management, production methods, and processes can compensate for the shorter hours and higher wages which, with other restrictions, place a burden upon industry. Otherwise, the increased prices brought about by the increased costs will go beyond the consumer's ability and willingness to buy.

* * *

Direct government assistance to industry must be looked on only as an emergency proposition in our present economic system. It can, in my opinion, be justified only on the basis that it is better to help regular establishments of a worthy character to re-establish themselves and employ the men who have been dependent on them than for the government to help through "make-work" programs of questionable economic value.

* * *

There is a further angle of the durable goods question that is scarcely ever mentioned, much less written about. It has been an axiom that the sobering influence of a depression causes the substantial type of man to think of a home—a roof over his head. But in *this* depression, that was useless, because the costs of building, due to rigidly controlled cost factors, especially labor costs, are out of all proportion to the incomes of people in other lines of endeavor, and out of proportion to the value of their savings. The idea that this condition should be changed must be accepted before this harmful state of unbalance can be corrected.

* * *

It is an unavoidable function of business men to take an interest in their local politics, to assist in getting men who understand something of industry to represent them, and further, to inform, personally, those who are elected. Not only is it wise to visit them in Congress in reference to pending bills, but it is wise to invite the Congressmen to plants to see how products are made and sold, and to get first-hand information on the real relationship of management and men.

* * *

Following the advent of mechanical power, progress in things industrial has been so rapid, and the executives of industry have been so wound up in the promotion of their own businesses, that they have not individually made it their business to analyze for themselves and portray to others the changes that have come about. The lifetime of a single man spans the period from the first long-distance traveling by mechanical power on rails to comfortable traveling by airplane. Coincident with this, was the introduction and wide distribution of a variety of things that make for a higher standard of living, enjoyed by a constantly increasing proportion of the people.

The addition of a number of things that go to make for a higher standard of living, so far as physical comforts are concerned, and the increase of the range of people who can enjoy these comforts, have come about in such a way that they have been taken for granted. The very vehicle of the contribution of these physical comforts has been derided in the onslaught against the machine age. It now behooves industry to resist unjust claims that are made against it, and at the same time, to make corrections where criticisms are justified.

* * *

Industry has done a marvelous job in invention, in design, and in processing, as individual units; but it is also the job of industry to study its relation to agriculture, to labor, and to finance, to give a square deal to all of them, and to insist on getting a square deal in return—this for the simple reason that none of them can long be successful or do its part while any other is unhealthy.

* * *

The very nature of the training and work of engineers is based on mathematics and technical accuracy. During the past year, I have often wondered what would have been the effect had the work of the great number of intellectual professors on the various phases of the New Deal been supplemented by practical engineers from industry. It would seem that many of the difficulties and inconsistencies would have been avoided. Engineers should be encouraged to bring their trained minds to bear on broader questions and to advocate their convictions.

* * *

We have had a veritable deluge of people promoting the idea of enjoying *more* by producing *less*, while there are tens of millions of people in our country living in unfit homes and having none of the accepted comforts of life.

The reformers do not have a corner on promoting the well-being of the whole people. Men in industry have social consciousness as well as others, and are usually more practical. They have done their good works in deeds; it is now time to tell what they have done and what should be done, and at the same time to keep on doing.

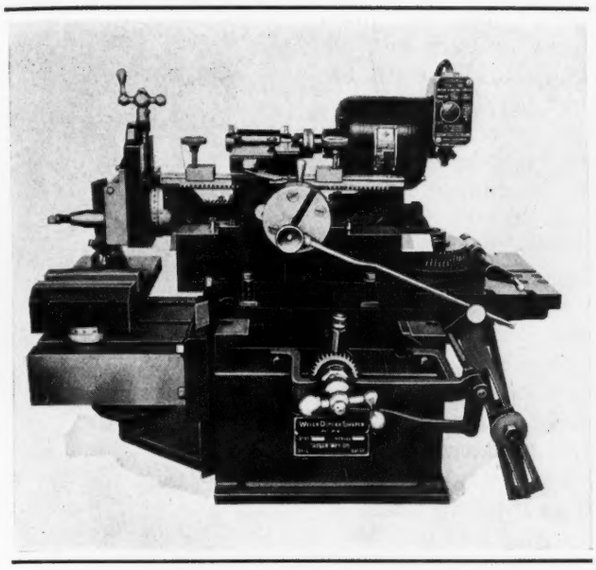


Fig. 1. A Machine that can be Used as a Shaper or Quickly Converted into a Slotter

A Shaper and Slotter All in One

Both horizontal and vertical cuts can be taken on a bench machine recently brought out by the Wells Mfg. Co., 6239 King Ave., Bell, Calif., by merely converting it from the shaper illustrated in Fig. 1 to the slotting machine shown in Fig. 2, or vice versa. The brace that supports the ram unit in the vertical position is graduated in degrees, so that the unit can be accurately positioned at various angles for machining tapered surfaces. A spring that balances the ram, regardless of the angular position, can be adjusted while the machine is in operation.

The ram can be operated at strokes ranging from 3/4 inch to 9 1/2 inches. Keyways can be cut in long shafts by passing the shafts under the ram in a space that has been provided to accommodate such jobs. The bed for the cross-slide can be clamped in various positions on the hinged member.

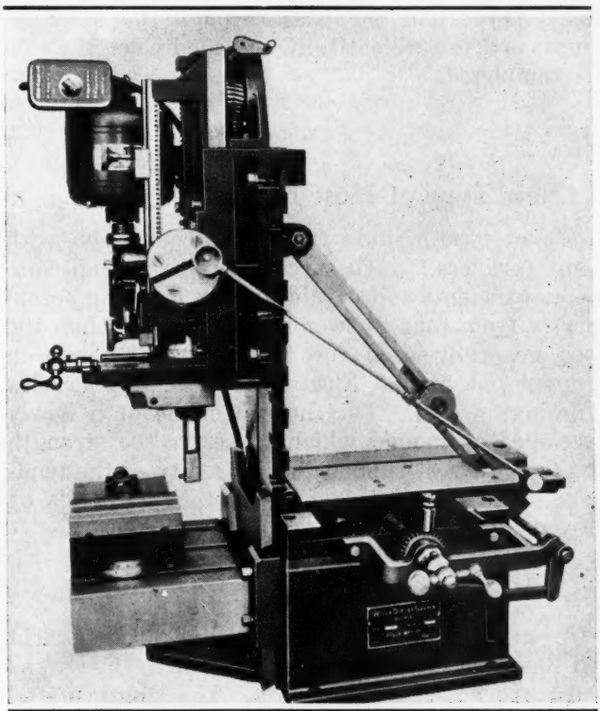
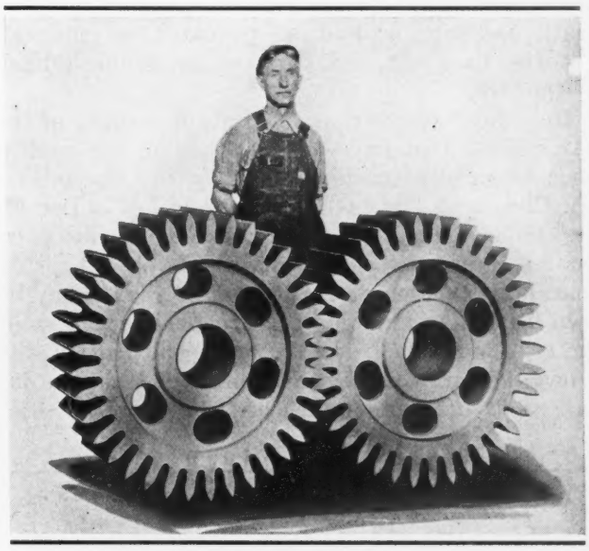


Fig. 2. How the Machine Shown in Fig. 1 Looks when Set up for a Slotting Operation

* * *

Gears with Flexible Teeth have Shown Little Wear

Two "flexible-tooth" gears which have epicycloidal addenda and radial flanks are shown in the accompanying illustration. These gears were generated on special Gleason gear planers, and are designed to have at least three teeth in working contact at all times. Each tooth can flex a fraction of a thousandth of an inch when it comes into initial contact with its mating tooth; thus the pressure is distributed among the three pairs of teeth that are theoretically under load. This reduces the individual tooth load, and is said to result in the maintenance of a better oil film, as well as to practically eliminate shock and acceleration forces, so that quiet operation is obtainable even at speeds formerly considered impracticable with large-sized spur gears.



Two Gears with Teeth Designed to Flex Enough to Distribute the Load Over Three Pairs of Teeth

Gears with these flexible teeth have been made by the Roots-Connersville Blower Corporation, Connersville, Ind., for about six years. The gears shown are 36 inches in pitch diameter and have a face width of 16 inches. They are designed to transmit 1000 brake horsepower at a speed of 360 revolu-

tions per minute, or a pitch-line velocity of about 3400 feet a minute. Gears of this type are working at pitch-line velocities up to 6000 feet a minute. The pair of gears shown weighs 5100 pounds.

The metal used in making gears with this style of teeth must have the properties of easy machineability and resistance to fatigue and wear. After several years of continuous service, gears similar to those shown have had practically no wear and their tooth surfaces have been burnished to a high degree of hardness.

* * *

Indexing Fixtures Facilitate Multiple Cuts in Broaching

Grooves, tongues, and flats are required in multiple in many parts such as are illustrated in Fig. 2. Pieces of this kind are particularly adapted for production by broaching, but in order to obtain high rates of manufacture, some means of automatic indexing should be provided, so that all grooves, flats, etc., can be broached in one setting of the work.

Indexing fixtures that facilitate broaching of the parts illustrated have been applied to the continuous broaching machine built by the Foote-Burt Co., Cleveland, Ohio, which was described in December, 1933, MACHINERY, page 242. Fixtures designed for use in broaching the square ends on the spring shackle pin shown at the bottom of Fig. 2 may be seen in Fig. 1 mounted on a broaching machine of the type mentioned. In the latter illustration, the broach-holder is shown dismantled, so that the indexing fixtures and upper broaches may be seen.

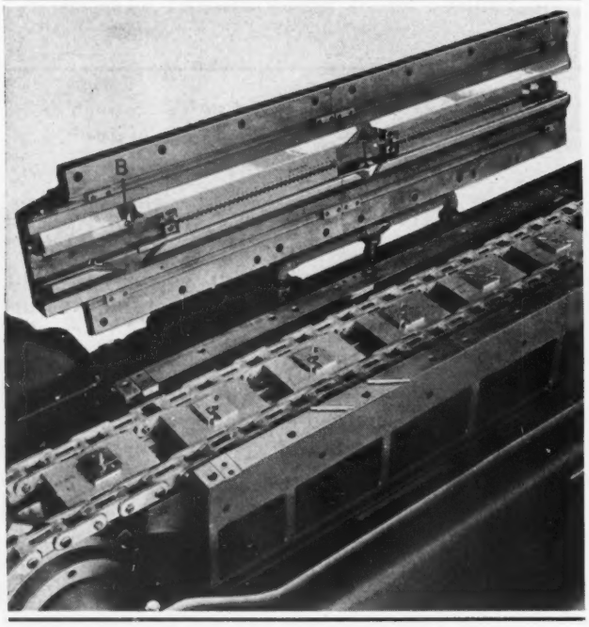


Fig. 1. Continuous Broaching Machine Equipped with Indexing Fixtures for Handling the Spring Shackle Pin Seen at the Bottom of Fig. 2

Two flats are produced on each end of the shackle pins as they pass between the first set of broaches at the right-hand end of the machine. Then, as each fixture leaves these broaches, the diagonal groove in the fixture engages a pin located on the broach-holder at *A*. With the continuous movement of the fixture past pin *A*, the fixture is indexed a quarter turn, to position the shackle pin correctly for broaching the remaining flats on its ends. When the indexing fixture leaves the second pair of broaches, it is again returned to its former indexed position by pin *B*. The shackle pins are automatically ejected as they pass beneath the sheave at the left-hand end of the machine.

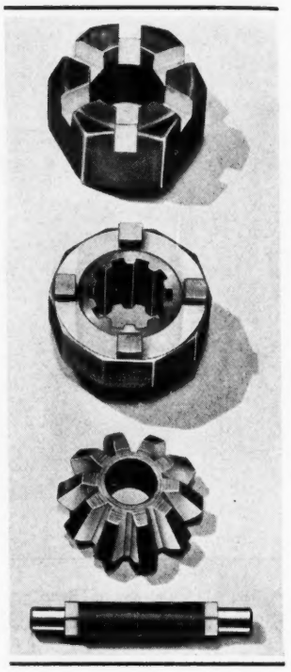


Fig. 2. Parts Broached in One Loading by the Use of Indexing Fixtures

Cam blocks such as shown in Fig. 2 second from the top, are finished in much the same manner. These parts pass through the broaching machine only once, two sets of broaches being used. Such pieces as the castellated nut and the bevel gear must make more than one pass through the machine. They are also automatically unloaded when the cuts are completed.

* * *

New Type of Hose for Paint Spraying

A new type of hose for use in connection with paint sprayers, which successfully resists all commercial solvents and is said to have lasted in actual service from four to twenty times longer than the hose generally used for this purpose, has been brought out by the Electric Hose & Rubber Co., Wilmington, Del. This hose is made of a newly developed compound which possesses the strength and flexibility of rubber, but is free from the tendency to deteriorate when in contact with oils or solvents.

* * *

One of the largest welded pipe lines in the world will soon connect the Bouquet Dam with the Owens Valley Aqueduct in California. The length of the pipe line is 4 1/2 miles. It is from 80 to 94 inches in diameter, the 80-inch section being 1 1/16 inches in thickness.

The Service Problem in the Machine Tool Industry

An Experienced Sales Engineer Gives His Views on the Subject of Service to Customers

THE service to be given customers has always been one of the difficult problems of the machine tool industry. I believe that the service to a customer should be controlled by the sales engineer in the field rather than by the home office or by the user of the equipment. No sales manager or other representative of a manufacturing concern, who gains his knowledge of a customer through written reports or brief hurried visits, can dictate intelligently to the field man the extent of the service that should be given to any one customer. On the other hand, many customers try to get all the service possible and are inclined to be unreasonable in their demands. Unless handled with the understanding of the field man, they may expect assistance far in excess of what rightfully belongs to them.

The service man, sales engineer, or engineering salesman—the title does not matter—is the connecting link between the machine builder and the user. He is directly responsible for the volume of business from his territory, and he knows that equipment that operates inefficiently does not bring repeat orders. He is in a position to have a clear conception of the best interests of both his customer and his employer.

Thoroughly acquainted with every detail of the equipment of his company, the sales engineer must be a teacher. He must be able to instruct the user intelligently in the operation of the equipment. He must be able to show the correct methods of overhauling and repairing, and the correct way to locate and overcome difficulties.

He must also be able to differentiate between real and fancied troubles, and to point out where the methods of operation are incorrect. If he finds that an operator or foreman does not cooperate with him, he must not hesitate to carry his suggestions to the highest authority. The need for this, however, seldom develops if the matter is handled diplomatically.

A sales engineer must maintain the confidence, respect, and good will of the men in the plant with whom he comes in contact, and he must not be afraid to take off his coat, roll up his sleeves, and go to work. He should try to obtain as an assistant the man who will care for the machine, so that he may instruct him how to remedy minor troubles. He should, as far as possible, get the properly trained men in the shop to look upon him in the light of a consultant rather than to expect him to come into their shop and do their work.

Some years ago I had an experience with a manufacturer using equipment for the first time that was not of a particularly intricate design. Nevertheless, on the first indication of anything unusual, the superintendent wired or phoned for the sales engineer. Requests for service increased to as often as two or three times a week, and for such trivial matters as the changing of a broken spring or the taking up of a leather belt that had stretched. Finally, it came to the point where the superintendent phoned if he just had the idea that "things did not look right."

This was a case where the sales engineer had erred by giving the customer too much attention from the first. He finally was forced to inform the superintendent and the foreman of the department that in the future they would have to depend on themselves, and he made it clear by questioning, that the mechanic in charge of the machine was capable and confident in his own ability to handle any condition that had arisen, but had not been given an opportunity. This plant today continues to use an increasing number of the same type of machines, but does not call for service oftener than once in six months. The sales engineer, however, calls about every two months to see that everything is satisfactory.

Nothing tends to discredit equipment more than the necessity for the user to call in outside assistance. It is far better for the sales engineer to make frequent, unsolicited calls until the operators are properly trained in the handling of the machine. In this way, he can guard against failure of the equipment due to lack of training on the part of the operators.

It is entirely practical to maintain such a service as outlined without additional charges to the customer. Well serviced equipment becomes more valuable to the customer and he is willing to pay the slightly higher initial cost necessary.

Furthermore, the rendering of service such as outlined creates a systematic method of developing new prospects. The sales engineer has an opportunity to do a real missionary job, something that the actual salesman, who has to follow up quotations or live prospects, cannot always do.

* * *

In official tests, an Allis-Chalmers tractor was recently driven at a speed of 64.3 miles an hour over a measured course. The use of Pyroil lubrication in this tractor is considered one of the important factors in its success.

MATERIALS OF INDUSTRY

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Magnesium-Base Alloys Advantageous When Lightness is Important

Magnesium-base alloys containing from 85 to 99 per cent magnesium are manufactured by the Dow Chemical Co., Midland, Mich., under the general trade name of "Dowmetal." The maximum specific gravity of these alloys is only 1.86, and the minimum 1.74. This characteristic of extreme lightness, in comparison with other structural materials, has led to the adoption of Dowmetals for widely varying purposes. These magnesium-base alloys are available in the form of die and sand castings, forgings, bars, sheets, plates, tubes, and extruded shapes.

The illustration shows a fleet of huge trailers, each of which can be used for transporting three new automobiles at a time. One car is held in an elevated position above the other two. These trailers weigh only 4900 pounds apiece, though they carry 8 tons of live load. Dowmetal sides form the only longitudinal carrying member between the truck and the trailer wheels, no chassis being required. Of the total weight of each trailer, about 3000 pounds is Dowmetal, the remaining weight being accounted for by the steel axle, walking beams, wheels, tires, brake equipment, etc.

Motor castings, bus seats, and horn disks are other applications of Dowmetal in the automotive industry. The airplane industry has replaced with magnesium-base alloys many parts formerly made from heavier metals, such as crankcases, instrument housings, landing and tail wheels, wheel-support assemblies, and seat trimmings. Gear housings, motor cases, and other parts of portable electrical and pneumatic tools are also made from magnesium-base alloys on account of their light weight. Other common applications of these alloys are found in machinery parts, household appliances, and office equipment.

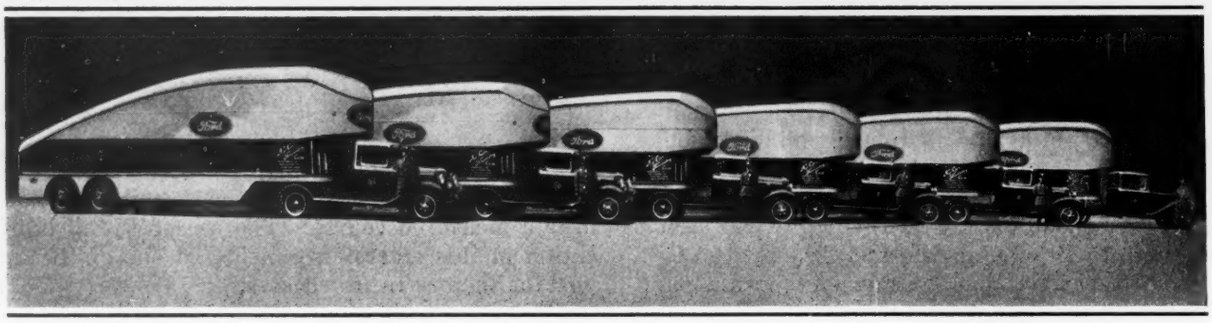
Fleet of Automobile-transporting Trailers Constructed Largely of Dowmetal to Obtain a Minimum Dead Load

Aluminum-Bronze Dies for Drawing Stainless Steel

Considerable difficulty is sometimes experienced in drawing and forming parts from stainless steel due to the affinity that stainless steel has for steels that are ordinarily used in making press dies. As a result, the die surfaces have a tendency to load up with particles of steel that scratch the work.

Aluminum bronzes known by the trade name of "Elesco" are made by the Superheater Co., East Chicago, Ind., for this service. As these bronzes do not have an affinity for stainless steel, they do not load up. Dies made from these bronzes are adapted for drawing and forming, but they are not suitable for blanking or other cutting operations.

Shells from 2 to 3 inches deep and from 2 to 3 inches in diameter have been successfully formed with such dies from 5/32-inch thick stock. The life of the dies depends upon the nature of the operation, but it is said to vary from 75 to 125 per cent of the life of hardened tool-steel dies.



The practice is to cast the aluminum-bronze dies to the desired shape, allowing about 1/8 inch of stock for finishing. After being machined, the dies are placed in service without hardening. The hardness of aluminum-bronze dies is approximately 302 Brinell.

Molybdenum Reduces Embrittlement Due to Prolonged Heating of Steel

Molybdenum, added in small quantities to steel, will prevent temper brittleness and greatly reduce embrittlement due to prolonged heating. According to H. A. Dickie in an article in *Engineering*, experiments carried on for a long period of time have proved that while molybdenum does not entirely prevent the changes leading to embrittlement, it does greatly minimize them. When the periods of heating are long, the actual content of molybdenum becomes important, and it is advisable to keep it above 0.5 per cent.

Carbon Tool Steel Now Produced by the Winged-Ingot Method

The Firth-Sterling Steel Co., McKeesport, Pa., is now producing a water-hardening tool steel known as "Special A.S.V." by the Winged-Ingot method. This method, which was described in August, 1933, MACHINERY, page 799, consists of casting steel in an ingot mold that has three wings. Any porosity, inclusions, gases, etc., are confined to the triangular center of the ingot, and so only the sound wings are forged into billets.

"Special A.S.V." steel is a suitable material for cold-working dies used in blanking, drawing, heading, trimming, embossing, stamping, engraving, and coining operations. This steel is also well adapted for such edge tools as punches, shear blades, special-purpose knives, and other tools requiring an intensely hard surface or keen edge in combination with a tough shock-resisting core.

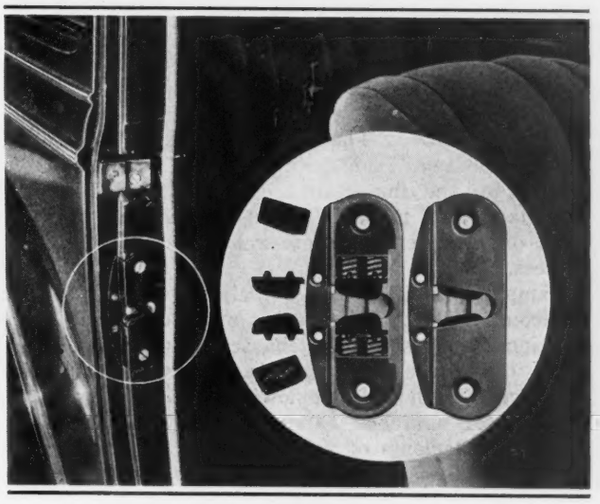
The carbon content in standard warehouse sizes of this tool steel ranges from 0.95 to 1.10 per cent, but the steel can be supplied with either a higher or lower carbon content. For forging operations, the steel should be heated to approximately 1700 degrees F., and no forging should be done below 1450 degrees F. Forged work should be annealed before machining or hardening by reheating to a temperature of about 1425 degrees F. and cooling slowly in the furnace or in dry ashes.

For hardening ordinary tools, the steel manufacturer recommends that the tool be preheated slowly to about 1200 degrees F. and then increased in temperature to around 1440 degrees F., at which point the tool should be held a sufficient time to insure uniformity of the heating, and then be quenched in clean cold water. Small and intricate shaped tools can be quenched at temperatures as low as 1375 degrees F., while temperatures as high as 1575 degrees F. are sometimes suitable for hardening large heading dies and similar work.

In tempering for the relief of strains, the parts should be heated to from 350 to 375 degrees F.; in tempering to reduce brittleness, to from 400 to 500 degrees F.; and in tempering to obtain toughness, to from 500 to 600 degrees F.

Camels Lose to Stainless Steel "Somewhere East of Suez"

Traffic on the famous caravan route between Damascus and Bagdad will soon be greatly speeded up by huge motor buses now being built in Cleveland. The first of these buses to be constructed is 68 feet long and is equipped with eighteen wheels. The body is fabricated from stainless chromium-nickel steel. A Diesel engine of 385 horsepower will drive the bus at a speed that will change the present arduous camel ride of from two to three weeks into a pleasant twenty-four hour journey.



Molded-plastic Bumper Shoes were Adopted for the Doors of Many 1934 Automobiles when it was Found that there were No Door Rattles or Squeaks in Cars Fitted with These Bumper Shoes after the Cars had been Driven from 25,000 to 30,000 Miles in Trial Tests over All Types of Roads. In Developing These Bumper Shoes, the Chicago Molded Products Corporation, Chicago, Ill., Found that Graphite could be Incorporated into the Molding Powder to Reduce Friction when the Bumper Shoes were Placed in Service and Thus Facilitate the Entry of the Wedges.

Durez Molded Compound of Extra Strength, a Product of General Pastics, Inc., North Tonawanda, N. Y., is Used for These Bumper Shoes. The Rubber Cushions on which the Molded-plastic Shoes are Mounted are Fitted with Coil Springs to Lengthen Their Life.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

Tapered Roller Bearings

BANTAM BALL BEARING CO., 3400 W. Sample St., South Bend, Ind. Catalogue on Bantam tapered roller bearings containing, in addition to regular catalogue data, technical information on load carrying capacities, safety factors for thirty-three different types of service, a speed capacity chart for all types of tapered roller bearings, and a chart showing the proper mounting fits for cups and cones. Over 1500 bearings are listed. It is planned to issue further catalogue sections covering bearings other than the tapered type, which, combined with the present publication, will form a complete anti-friction bearing catalogue.

Centrifugal Pumps, Air Compressors and Condensers

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Leaflet D-475-B9, descriptive of Worthington internal-bearing, double-helical rotary pumps. Bulletin W-311-B1, covering Worthington single-stage, volute centrifugal pumps. Circular L-612-S28, describing the advantages and construction of Worthington horizontal duplex refrigeration compressors equipped with feather valves. Bulletin W-200-B2, illustrating and describing Worthington welded-steel shell surface condensers of the patented folded tube layer type.

Welding Equipment

LINDE AIR PRODUCTS CO., Unit of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City. Pamphlet entitled "The Progress of Bronze-Welding," containing information on the important advances that have been made in the use of the oxy-acetylene bronze-welding process.

Pamphlet entitled "The Principles of Bronze-Welding," discussing compositions and strength characteristics of bronze-welding rods, the underlying theory of the flowing of bronze-weld material, and certain important elements of welding technique.

Files

HENRY DISSTON & SONS, INC., 725 Tacony, Philadelphia, Pa. Booklet on the selection and care of files. Tables of dimensions of files in general use are given, as well as illustrations showing the standard cuts of regular files and of superfine pattern files. The booklet also contains a partial list of files classified according to their shape, giving trade name, outline, "cut," and lines of work for which they are best adapted. Suggestions on the correct use of files are included.

Steel Belt Lacing

FLEXIBLE STEEL LACING CO., 4607-31 Lexington St., Chicago, Ill. 72-page book entitled "Short Cuts to Power Transmission," containing information required in solving any ordinary belt transmission problem, a discussion of belting of all types, information on belt joints and good transmission practice, as well as a number of useful tables. This is the fifteenth edition of this little handbook, the text having been completely revised and new chapters added.

Insulating Materials

JOHNS-MANVILLE, 22 E. 40th St., New York City. Technical folder containing information on the use of Johns-Manville Sil-O-Sel C-22 brick as a combination refractory and insulation for temperatures up to 2000 degrees F. The folder contains complete engineering information on C-22 brick, including data on conductivity, strength, permeability, expansion, deformation under high temperatures, and resistance to spalling.

Laminated Bakelite

SYNTHANE CORPORATION, Oaks, Pa., is distributing a new laminated Bakelite sample book, profusely illustrated with excellent reproductions of sheets, rods, tubes, fabricated parts, and possible machining operations. A distinctive feature is the presentation of actual samples of the material. On the page opposite the sample in each case, the properties, characteristics, colors, sizes, grades, and thicknesses are listed.

Insulated Cable

GENERAL ELECTRIC CO., 10 Canal St., Schenectady, N. Y. Publication GEA-1837, entitled "How to Select Insulated Cable." This booklet covers cable for the transmission and distribution of electric power at normal frequencies, and presents in convenient form the information that is required in determining the cable best adapted for a particular installation.

Gear Chamfering and Burnishing Machines

CITY MACHINE & TOOL WORKS, E. 3rd at June, Dayton, Ohio. Circular entitled "Reduce the Cost of Gear Chamfering," outlining the features of the Cimatool Peerless gear chamfering machine and illustrating the machine and its application. Bulletin entitled "Burnished Gears Operate More Quietly," illustrating and describing the Cimatool (Bolender) burnisher.

Portable Air Tools

ROTOR AIR TOOL CO., Cleveland, Ohio. Catalogue 10, covering this company's entire line of pneumatic drills, reamers, grinders, buffers, sanders, etc., together with the principal accessories used with these tools. The work for which each tool is especially adapted is listed, together with important specifications, in convenient tabular form.

Air Valves

C. B. HUNT & SON, Salem, Ohio. Bulletins Nos. 102-VC and 103-FV, describing the principle of construc-

tion of the "Quick-As-Wink" air valves, as well as their applications. Specifications and list prices are included. Bulletin 103-FV illustrates the application of these valves for regular and automatic three-way action and for four-way regular and automatic action.

Air Hoists

INGERSOLL-RAND CO., 11 Broadway, New York City. Bulletin 12107 on Ingersoll-Rand "Utility" air hoists of the single drum and double drum types, equipped with the "Joy Stick" control, a single lever by means of which the operator has complete control of the hoist. The available range of sizes and capacities for both types is given.

Speed Reducers and Flexible Couplings

LINK-BELT CO., 910 S. Michigan Ave., Chicago, Ill. Catalogue 1415, covering single, double, and triple reduction speed reducers of the herringbone gear type, as well as a full line of flexible couplings. Horsepower and other useful engineering data, dimension diagrams, etc., are included.

Spray Equipment

BURNING BRAND CO., 1400 W. Fulton St., Chicago, Ill. Bulletin calling attention to the advantages of the "Master" automatic production spray gun, which is provided with an adjustment that automatically controls both material and air. Prices are given for the gun alone, as well as for the complete spray outfits.

Electric Tools

STANLEY ELECTRIC TOOL CO., New Britain, Conn. Catalogue 64, covering the line of electric tools made by this company, which includes chucks, drills, grinders, hammers, disk sanders, saws, screwdrivers, cutting shears, etc. The special features of each tool are outlined and complete specifications are given.

Lift Trucks and Storage Racks

BARRETT-CRAVENS CO., 3255 W. 30th St., Chicago, Ill. Leaflet pointing out the advantages of Barrett lift trucks and platforms, illustrated by views showing various applications. Circular illustrating Barrett storage racks, including barrel racks, die racks, platform racks, and single and double drain racks.

Roller Bearings

BANTAM BALL BEARING CO., 3400 W. Sample St., South Bend, Ind. Catalogue on printing press roller bearings, designed to eliminate vibration at high speeds. The booklet describes several special bearings, many of which have never been made before and are unknown to the majority of machinery users.

Vulcanized Fiber

TAYLOR & CO., INC., Norristown, Pa. Catalogue entitled "The World's Most Modern Mill for the Production of Vulcanized Fiber and Phenol Fiber," illustrating this company's plant and the equipment used in producing high-quality fiber. A list of suitable applications for these materials is given.

Chromium-Alloy Steel

FIRTH-STERLING STEEL CO., McKeesport, Pa. Circular giving typical analyses, uses, and heat-treatments of "C. Y. W. Choice Steel"—a chromium-alloy hot-work steel developed for applications where dies or tools are subjected to heavy pressure while in contact with hot metal.

V-Belt Drives

MEDART CO., Potomac and DeKalb Sts., St. Louis, Mo. Loose-leaf booklet entitled "Data and Price List," containing forty-two pages giving complete engineering and purchasing information on all types of Medart multiple and fractional horsepower V-belt drives.

Boring-Bars

R. V. RUSSELL, 1207 Calumet Ave., Middletown, Ohio. Circular illustrating and describing the Russell boring-bar, a heavy-duty adjustable bar with micrometer adjustment for boring holes from 9/16 inch to 12 inches in diameter on milling machines, drill presses, boring machines, and lathes.

Power Squaring Shears

NIAGARA MACHINE & TOOL WORKS, 637-697 Northland Ave., Buffalo, N. Y. Circular illustrating a Niagara power squaring shear that has been in operation for over eight years, as well as a recent Niagara shear available in a range of sizes up to 3/4-inch plate and in all lengths.

Keys and Keyseat Cutters

WHITNEY MFG. CO., Hartford, Conn. Catalogue V-111, describing the Woodruff system of keying, and containing tables of Woodruff key dimensions, keyseat and keyway dimensions, and keyseat cutter dimensions. Data are included on Whitney keyseat milling cutters.

Aluminum Alloys

ALUMINUM INDUSTRIES, INC., Cincinnati, Ohio. Catalogue containing a list of Permite parts for all models in the Ford, Chevrolet, and Plymouth group of automobiles. Many new aluminum and semi-steel pistons, piston-rings, and bushings are included in the listings.

Indicating, Recording, and Controlling Instruments

ESTERLINE-ANGUS CO., Indianapolis, Ind. Pamphlet entitled "Solving Industrial Crimes," describing how Esterline-Angus graphic indicating and recording instruments are used in reducing operating costs in industrial plants.

Cromansil Steel

LUKENS STEEL CO., Coatesville, Pa. Bulletin on Lukens Cromansil steel, a recently developed high-strength steel available in sheet and plate form. Information is given on the physical properties, fabrication, riveting, welding, and applications of this steel.

Tube Couplings

PARKER APPLIANCE CO., Cleveland, Ohio. Bulletin 35, listing the various products of this company, which include tube couplings, valves, cocks, engine primers, seamless tubing, tube cutters and benders, tube flaring tools, manifolds, heat exchangers, coils, and bent or fabricated tube.

Twist Drills and Reamers

UNION TWIST DRILL CO., Athol, Mass. Catalogue 40, containing tables of dimensions and prices of the complete line of twist drills and reamers made by this concern. Suggestions for ordering are given, and a complete index for convenient reference is included.

Bakelite Synthetic Resins

BAKELITE CORPORATION, River Road, Bound Brook, N. J. Booklet entitled "Bakelite Synthetic Resins for Paints and Varnishes," outlining the properties and characteristics of Bakelite and its advantages for the class of service mentioned.

Cold-Drawn Steel

UNION DRAWN STEEL CO., Massillon, Ohio. Bulletin entitled "Selecting the Steel," giving information of value to the steel user in selecting the right steel for his product, and pointing out the particular advantages of cold-drawn steels. Examples of cold-drawn parts are shown.

Electric Equipment

SQUARE D CO., Detroit, Mich. Condensed illustrated catalogue of 40 pages, giving information and prices on the products manufactured in both the switch and panel division and the industrial controller division of this company.

Multi-V Drives

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Leaflet illustrating Worthington multi-V drives, which are made in 25,000 stock combinations for any power requirement from fractional to 1500 horsepower.

Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Circular entitled "The Importance of Proper Selection of a Protective Welding Lens," pointing out the advantages of the Lincoln Super Visibility protective lenses for welding operations.

Pumps

DEMING CO., Salem, Ohio. Catalogue 30, containing 160 pages of data covering the Deming line of pumps, water systems, and auxiliary parts and equipment. Engineering information is included.

Variable-Speed Transmissions

REEVES PULLEY CO., Columbus, Ind. Booklet illustrating and describing the features of construction of the Reeves variable-speed transmission, which is designed for infinite speed regulation.

Electric Switches

ROLLER-SMITH CO., 233 Broadway, New York City. Catalogue 9, illustrating and describing a new line of instrument and control rotary switches for switchboards and control panels of all kinds.

Conveyor Chain

WHITNEY MFG. CO., Hartford, Conn. Bulletin V-109, descriptive of the Whitney platform roller type conveyor chain designed to meet the requirements of bottling, packaging, and similar machinery.

Electric Motors

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Leaflet 2173, descriptive of squirrel-cage induction motors which are made in designs suitable for special as well as standard applications.

Sheet-Metal Slitting Machines

WATERBURY FARREL FOUNDRY & MACHINE CO., Waterbury, Conn. Folder illustrating this company's improved line of sheet-metal slitting machines.

Blowers and Exhausters

ROOTS-CONNERSVILLE CORPORATION, Connersville, Ind. Bulletin 120-B10, illustrating and describing single-stage centrifugal blowers and exhausters.

Fiber Sheets and Tubes

WILMINGTON FIBRE SPECIALTY CO., Wilmington, Del. Price list of Wilmington fiber sheets, "Fyberoid" (fish paper), fiber tubing, and fiber rods.

Cast-Iron Pulleys

T. B. WOOD'S SONS CO., Chambersburg, Pa. Circular illustrating Wood's cast-iron pulleys.

Industry Reports Improved Business

The May output of motor vehicles amounted to 336,657 units, according to the National Automobile Chamber of Commerce. This is a gain of 48 per cent over May, 1933. The production for the first five months of the year was 1,477,770 units, an increase of 88 per cent over the corresponding period last year.

The Timken Steel & Tube Co., Canton, Ohio, announces that the electric furnace department of the company poured more steel in May than ever before in the history of the company, the total for the month being nearly 15,000 tons of electric furnace alloy steel. The electric furnace production during the first five months of the year was over two and one-half times that of the corresponding period last year.

Thomas Prosser & Son, New York City, manufacturers of Widia cemented carbide cutting tools, write us that business in Widia tools increased 321 per cent during the first five months of 1934, as compared with the same period last year. Part of this increase is attributable to the increase in machine shop operations at the present time, but a large part is due to the fact that more and more concerns are adopting cemented carbide for cutting tools for both production and job shop work.

The Bunting Brass & Bronze Co., Toledo, Ohio, states that business is so much better that four major sales representatives have been added to the present Bunting sales staff now operating in sixteen branch offices situated in leading industrial centers.

Youngstown Sheet & Tube Co. announces that it will install at its Campbell Works a new wide continuous hot-strip mill, conforming to the latest practice in the design of rolling mill machinery. Under normal demand, the monthly capacity of the new mill will be from 40,000 to 60,000 net tons. Contracts for the new mill have been let to the Mesta Machine Co.

The Meriam Co., Cleveland, Ohio, reports that the company's sales of flow and pressure meters have practically doubled during the last three months.

The Black & Decker Mfg. Co., Towson, Md., announces that the company has shown a progressive increase in business ever since the beginning of October last year.

Ajax Electrothermic Corporation, Trenton, N. J., announces the sale of four 300-K.W. Ajax-Northrup melting furnaces to the U. S. Navy Yard at Washington for the production of alloy steel castings. Since January, 1931, Ajax-Northrup furnaces equivalent to 19,000 K.W. have been installed—an encouraging accomplishment during the depression period.

The Aluminum Industries, Inc., Cincinnati, Ohio, manufacturers of Permite products, mention that the sales of aluminum paint have exceeded by 25 per cent any past record. A. B. Anderson, manager of the paint division, ascribes this increase in sales to advertising, stating that "our advertising has developed a market among industries that have been waiting for a heat-resisting and non-corrosive product to fit every industrial need."

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market

Heald Grinding Machine Developments

Three grinding machines designed specifically for different classes of work, are recent developments of the Heald Machine Co., Worcester, Mass. The machine illustrated in Fig. 1 is for finishing the ends of cluster gears to length within a close tolerance. Another important specification on this job was that any finish marks on the gear ends must be concentric with the center of the gear instead of crisscrossing each other. As may be seen in Fig. 1, the machine was constructed with a T-shaped base, and it embodies the standard hydraulic table-driving mechanism of the No. 72A internal grinding machine built by the concern. The machine also has the standard cross-slide for the wheel-head.

On top of the T-end of the base there is a bridge with a swivel adjustment which permits of squaring up the work with the wheel. This bridge is equipped with a headstock and tailstock for centering and holding the cluster gear to be ground. The headstock is motor-driven. It is provided with a spring center and faceplate for positively locating the cluster gear and its driver endwise. The operator can turn the gear end for end, in order to grind both ends.

The tailstock is supplied with a dead center, and it is adjustable to take care of various lengths of gears. A positive stop definitely controls the length of table stroke. The Red Head wheel unit is furnished with a 5-inch wheel which can be worn down to a diameter of 2 7/8 inches. The required speed to suit the reduced wheel diameter, is obtained by using a two-speed motor for the wheel-head.

The second new machine of the concern is arranged for grinding single airplane cylinders, long sleeves and other work of a similar nature. This machine, which is illustrated in Fig. 3, is equipped with a hollow type of work-head. Since an airplane cylinder is bolted to the engine by a flange and centralized by a turned diameter of the skirt, the fixture was designed to locate from these surfaces. Thus, the bore is ground at a true

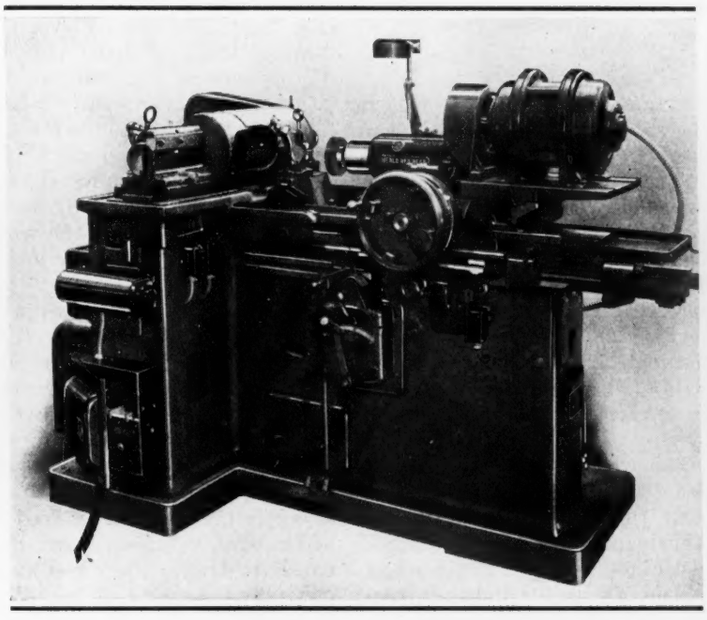


Fig. 1. Heald Machine Designed Especially to Grind Cluster Gears Accurately to Length

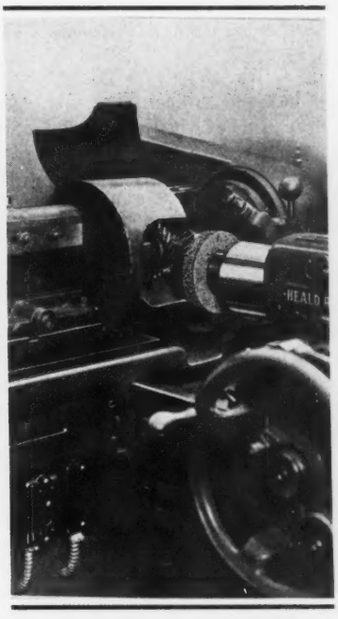


Fig. 2. Grinding Wheel-head and a Typical Cluster Gear

right angle with the flange and concentric with the periphery of the skirt.

In chucking an airplane cylinder, an adapter ring is first bolted to the flange and then a bracket with a stud is fastened to the rear. The cylinder is next loaded into the work-head from the right-hand end and is centralized by six locating pins. Bars guide it into position. The adapter ring is then clamped against three positive stops by bolts operated from the front. These so lock the cylinder that the bore is concentric with the center line of the work-head and square with the flange. A strap with a self-aligning end support is slipped over the stud on the bracket at the rear and clamped to the work-head spindle to offer a support against the wheel pressure. Two adapter rings and brackets are furnished with each machine to enable the operator to prepare one cylinder for the operation while another is being ground.

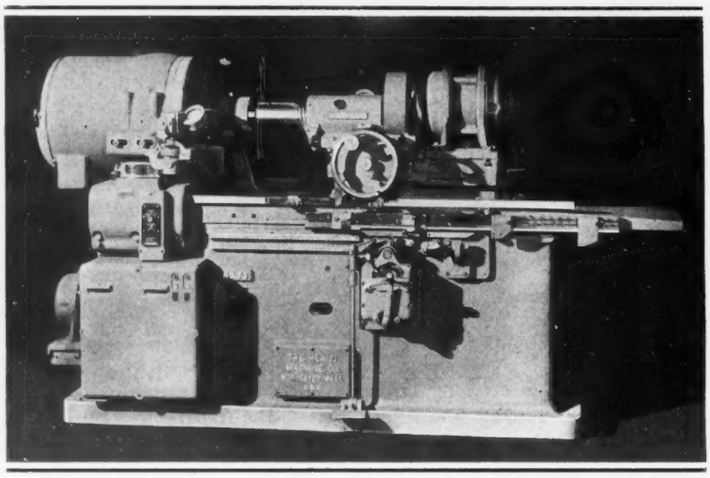


Fig. 3. Heald Grinding Machine for Finishing the Bore of Single Airplane Cylinders and Similar Work

The general design of the machine is similar to other internal grinders built by the company except that the base is much heavier and is provided with wider table ways. These ways are pressure lubricated. All switches and other electrical connections for the various motors are contained in one terminal box on the front of the base. An "inch" switch permits the wheel spindle to be jogged around in setting up the machine.

The table is actuated by the usual Heald hydraulic drive which provides a great variety of speeds and insures smooth table movement. The hollow spindle of the work-head is mounted in two precision ball bearings. It is of such construction as to permit generous lubrication and at the same time to prevent the entrance of water, dust or other foreign substances. The hole in the spindle is 10 inches in diameter.

The work-head is driven by multiple V-belts from an individual motor. In this drive there is a double pulley mounted on an adjustable jack-shaft, an arrangement that provides for keeping all belts tight so as to eliminate all vibration. The base plate of the work-head drive motor is carried on vibration dampeners.

The wheel-head motor is carried by a base that is separate from the cross-slide. This arrangement prevents the transmission of vibration to the wheel spindle. The motor and the cross-slide move together when the wheel is fed into the work, so as to maintain the proper tension on the belt. The wheel-spindle drive also incorporates a jack-shaft that is adjustable for obtaining the desired belt tension. The wheel-head is of the Red Head design, and is built with a long large body especially for this machine. The main drive motor and oil pump are also mounted on a base plate that is carried on vibration dampeners.

The third machine being introduced on the market by the Heald Machine Co. is shown in Fig. 4. It is a small internal grinding machine that can be operated either manually or automatically. Except for the provision for hand operation, this machine is of the same general construction as the No. 81 internal grinder described in January MACHINERY, page 304. The machine is hydraulically actuated. When run as an automatic machine, sizing of the work can be controlled either on the Size-Matic or the Gage-Matic principle.

When the machine is to be hand-operated, knob *A* is turned clockwise to stop the delivery of oil under pressure to the cross-feed screw. Then the wheel-slide can be moved in to the work radially either by turning handwheel *B* or by moving lever *C* to the right. As long as lever *C* is held in the right-hand position, the cross-feed will continue, but as soon as the operator allows the lever to return to the position shown, the cross-feed stops. If it is desired to back the wheel away from the work, lever *C* is moved to the left. However, the wheel can also be withdrawn by means of handwheel *B*.

The table can be reciprocated either through handwheel *D* or hydraulically. In the latter case, the table is reversed automatically by the usual dogs. Handwheel *D* is especially convenient in setting up the machine for an operation.

When the hand cross-feed is being used, no means are provided for truing the wheel automatically. Lever *E* is moved to the right, causing the table to make an extended stroke, which is controlled in the same manner

as on the regular Gage-Matic and Size-Matic machines. As the table moves out on the extended stroke, the truing device is hydraulically lowered into the path of the wheel. Upon the return of the table to bring the wheel and work back into the grinding relation, the truing device is positively raised clear of the wheel-head by means of a cam.

If the operator desires to run the table out to the rest position, he moves lever *E* to the left to lift the table dogs clear of the reversing lever. The rotation of the work-head is automatically stopped when the table reaches the rest position. The chuck or fixture is opened hydraulically by moving lever *F* to the right.

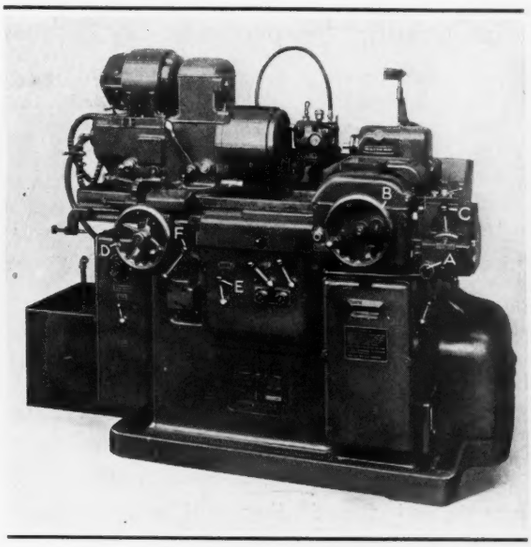


Fig. 4. Small Internal Grinder Arranged for Hand or Automatic Operation

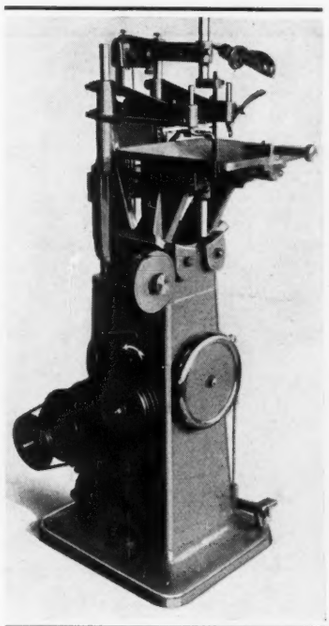
A pump gives a continuous blast of air to keep the work clean. The table tilts 15 degrees to the front, right, and left, and 3 degrees to the rear. It is held on a heavy cradle attached to the bed. Permanent alignment of the cutting tool is insured by a cross-head at the rear of the machine.

An important feature of the machine is a hydraulic device which provides a constant controllable tool pressure on the down stroke of the ram and relieves the pressure entirely on the up stroke. The feeding pressure can be adjusted by means of a knurled knob at the side of the machine. The feeding device requires the constant attention of the operator; if left to itself, the device will feed a short distance and then stop, so that work cannot be spoiled by an operator leaving the machine running without his attention.

Oliver Heavy-Duty Diemaking Machine

An improved heavy-duty machine for performing sawing and filing operations on dies and other tools has been added to the line of diemaking machines which have been built by the Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich., for almost twenty years. This machine has a capacity for sawing metal up to 3 inches thick and for filing still heavier material. The stroke is adjustable for 0 to 5 inches. Six operating speeds of from 100 to 300 strokes a minute are obtainable.

Any type of parallel file or any size of saw from the smallest to heavy machine saws can be held in the clamps of the machine without previous preparation. The ram which reciprocates the cutting tool is made of steel tubing 2 inches in diameter and is provided with 10 inches of bearing surface. The arms that hold the tool are provided with universal clamps which are adjustable vertically, so that the file or saw can be gripped close to the work. The upper arm is hinged, and can be turned back for easy removal of the work; it can also be removed entirely. Adjustable saw guides are provided above and below the table.



Oliver Heavy-duty Machine for Sawing and Filing

Superex Insulating Blocks for High Temperatures

Blocks of Superex insulation intended for use behind the refractory linings of furnaces subjected to temperatures of between 600 and 1900 degrees F. are being introduced on the market by Johns-Manville, 22 E. 40th St., New York City. Superex insulation is made of selected and calcined diatomaceous silica, blended and bonded with asbestos fiber.

The material has a low thermal conductivity, will withstand high temperatures with negligible shrinkage, weighs only about 23 pounds per cubic foot, and possesses ample strength for the purposes for which it is intended. These blocks are regularly available in standard sizes of 3 by 18 inches and 6 by 36 inches, both flat and curved, and in thicknesses of from 1 to 4 inches.

Rockford "Hy-Draulic" Shaper

Complete hydraulic operation is the outstanding feature of the "Hy-Draulic" shaper here illustrated, which has just been developed by the Rockford Machine Tool Co., Rockford, Ill. Hydraulic power delivered direct to the ram provides three ranges of cutting pressures in the 24-inch model and two ranges in the 16-inch model. The cutting speeds are infinitely variable from 0 to 120 feet a minute on the larger machine, and from 0 to 144 feet a minute on the smaller model. The ram speed can be adjusted closely to meet the requirements of each individual job. The ram cannot "run away" as the cut diminishes or is interrupted.

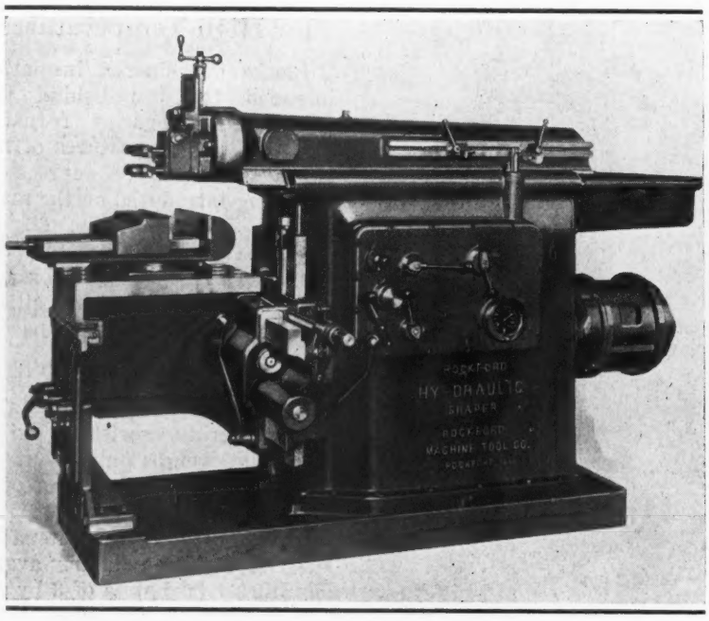
One of the important advantages derived from the use of hydraulic power for driving a shaper ram is that the cutting speed and cutting pressure are uniform from the beginning of the stroke to the end. The maximum capacity of the tool can be used and ample pressure provided to cut the metal at any selected speed without wasting power. The acceleration from zero at the beginning of the stroke to the full cutting speed and pressure is extremely rapid. Reversals of the ram are accomplished without shock.

The return stroke of the 24-inch shaper is at the high rate of 185 feet a minute, and of the 16-inch model at the even higher rate of 193 feet a minute. The return speed is constant, regardless of the length of stroke or of the cutting speed. Because of the hydraulic drive, the ram parts can be made simple in design and of light weight, and the ram mechanism is self-lubricated.

Hydraulic power is also utilized for feeding and rapidly traversing both the table and the rail, there being no intervening mechanical devices. Any feed from 0 to 0.250 inch per ram stroke can be selected instantly by turning a dial on the control panel at the side of the machine. The feed movement cannot begin until the tool has cleared the work on the return stroke, and it takes place practically instantaneously.

One pair of dogs controls both the length of stroke and its position relative to the work. These dogs can be adjusted safely by hand while the ram is in motion. A change in the length of stroke does not affect the cutting speed.

Another feature of the shaper is that the operator can instantly reverse the direction of ram travel at any point by simply moving a ball handle. All controls are centralized at the side of the machine. A single lever controls the direction of all feeds and rapid traverses. Starting, stopping, and "inching" of the ram are controlled by another lever. The table support is clamped and released by manipulating a lever at the front of the machine. There is a micrometer stop for the cross-feed that insures high quality work.



Rockford Shaper with Hydraulic Drive that Insures a Constant Cutting Speed and Pressure

Improved "Sta-Put" Lubricants

E. F. Houghton & Co., 240 W. Somerset St., Philadelphia, Pa., have announced an important development in their line of oils and greases that bear the trade name of "Sta-Put." These products were so named because the research laboratories of the concern succeeded about two years ago in increasing the ability of mineral oils to stay in place by treating them with selected mineral hydro-carbons. In this way, straight mineral oils with "stay-put" qualities were created for general lubrication.

Now the research staff has made a further step by chemically combining certain other hydrocarbons, which greatly increase the load-carrying capacity of the oil by giving an increased film strength in addition to the "stay-put" properties. This combination decreases wear on parts and reduces maintenance requirements.

Shock loads or sudden reversals of strain on a bearing are adequately met by comparatively light weights of oil without the addition of any materials that would cause a change in the appearance of the oil, interfere with the use of the oil in the way that other mineral oils are used, or promote deterioration or thickness in use or storage.

Milwaukee Face-Mill Grinder

A grinding machine basically designed for the rapid sharpening of tungsten- and tantalum-carbide milling cutters is being introduced on the market by the Kearney & Trecker Corporation, Milwaukee, Wis. This machine has been designed with a view to materially reducing the time required for sharpening not only cutters of the types mentioned, but high-speed steel and Stellite cutters as well. The machine has a capacity for all face milling cutters up to 16 inches in diameter.

The entire machine is constructed to possess the necessary strength and rigidity for the fast and accurate sharpening of cutters. All sliding surfaces are broad and are fully protected to reduce wear. The cutter-spindle is of large diameter and is mounted in Timken roller bearings. It has the standard milling machine spindle nose, so that any cutter mounted on a Style C arbor can be sharpened without removing the arbor. This practice eliminates chances of error. Large-diameter cutters are bolted to the spindle nose so that adapters are unnecessary. The cutter-spindle housing is mounted on an upright that can be swiveled to any angle.

Graduated dials are furnished on all adjustment screws to simplify set-ups. A Federal jeweled-bearing dial indicator that reads to 0.0005 inch is furnished as standard equipment. The indicator is permanently mounted on the wheel-spindle slide directly in front of the operator. With this indicator, the accuracy of finished cutters can be quickly checked and cutters can also be checked before grinding to see if they have been run too long and become wastefully dull.

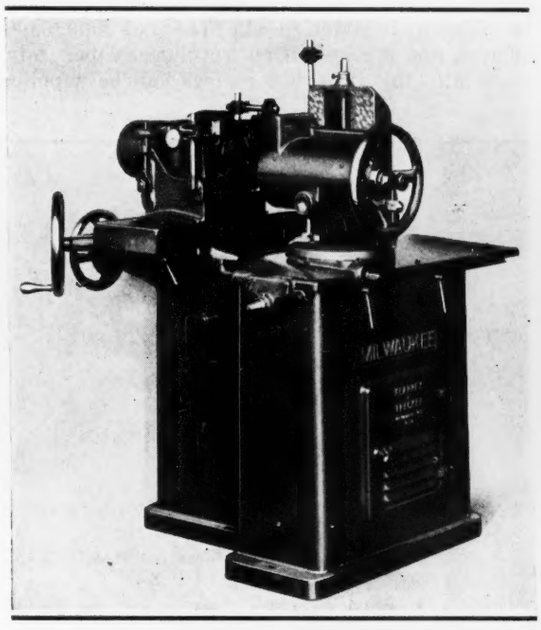
The wheel-spindle is mounted in three anti-friction bearings. There is a 55-pound flywheel on the spindle between the front and center bearings. The inertia of this flywheel keeps the grinding wheel running smoothly at all times. A brake is provided for stopping the spindle quickly after the motor has been turned off. A complete blower system can be furnished as an integral part of the machine for plants that do not have a central exhaust system.

Steptoe Shapers with V-Rams

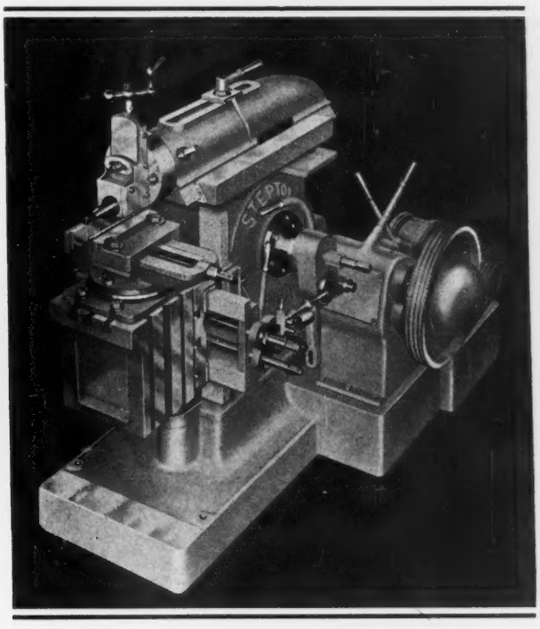
All of the Steptoe shapers manufactured by the Western Machine Tool Works, Holland, Mich., are now built with a V-type ram as illustrated. The line includes shapers ranging from the 14-inch single-gear type to the 24-inch back-gear type. These machines are equipped with an extra large head that can be swiveled through an arc of 120 degrees. Bronze and felt retainers keep all ways clean and oiled.

The feed mechanism is of a new design with a finger-tip control, and all controls are centralized. Timken roller bearings are supplied for the various shafts. The speed-box is arranged with a Twin Disc clutch that provides sure and smooth engagement and release. The rocker-arm block is of a solid one-piece design.

The shaper illustrated is equipped with a Texrope drive



Grinder Designed for the Rapid Sharpening of Tungsten- and Tantalum-carbide Face Mills



Steptoe V-ram Shaper, which is Capable of Operating at 130 Strokes a Minute

from the motor to the speed-box. The machines can also be equipped with a forced-feed continuous lubricating system which includes a pump, Purolator oil filter, and pressure gage. One of the most important features of these new shapers is that the ram can operate at speeds up to 130 strokes a minute.

Taylor-Winfield Welders for Fabricating Streamline Trains

Welding has played an important part in the fabrication of the streamline railway trains that have been attracting so much attention during recent months. The use of heat-treated aluminum alloys in some of these trains has enabled a great saving in weight, but welding has also contributed materially toward that end by eliminating surplus metal and facilitating assembly.

Spot and roll seam-welders especially adaptable for this type of welding have been produced by the Taylor-Winfield Corporation, Warren, Ohio. The illustration shows the roll seam-welder. It is of a twin-transformer construction that provides a uniform distribution of power with minimum reactance and resistance losses. The lower roll is driven, the design thus taking all unnecessary weight from the upper roll. The latter is carried at the end of an arm made of a special light alloy which provides maximum strength and electrical conductivity.

This upper roll-carrying arm is operated smoothly by a cushioned air cylinder. The roll pressure is adjusted and maintained uniformly through a pressure-reducing valve. These features are particularly advantageous in view of the fact that the slightest hammer-blow effect when the rolls come in contact with the work has a tendency to bed them into the aluminum alloy, producing a detrimental effect on the welding.

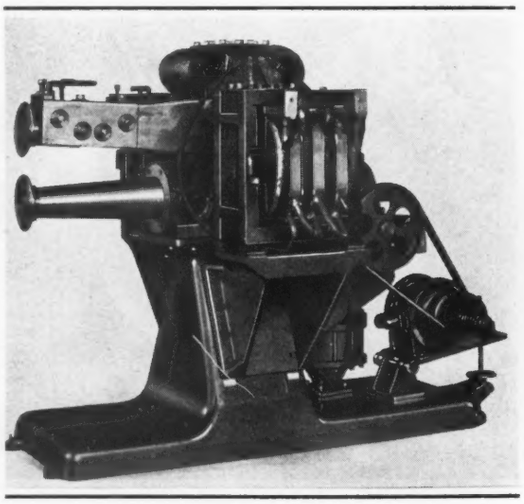
An infinitely variable speed drive provides welding speeds of from 40 to 240 inches a minute. The welding head is controlled in very close steps through the use of an auto-coil that has a twenty-step regulator. It is recommended by the manufacturer that a General Electric Thyratron unit be used to obtain proper interruption of the welding current.

Defiance Oil-Groove Grinding Machine

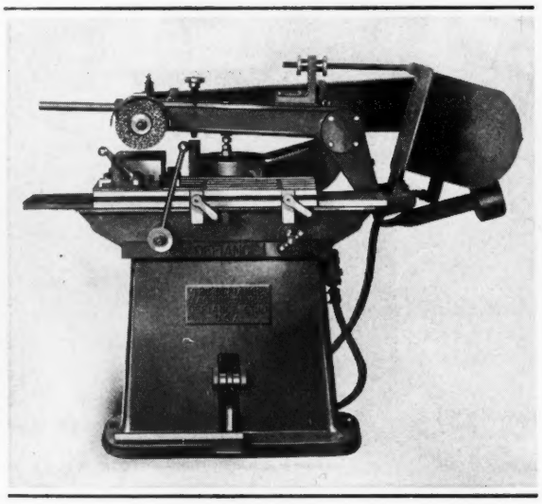
A special machine for grinding grooves in hardened pins, shafts, etc., for oiling and other purposes has been developed by the Defiance Machine Works, Defiance, Ohio. This machine can also be employed for grinding flat spots, cutting off pieces of work, and similar operations requiring a high-speed grinding wheel or abrasive cut-off wheel.

The table has a machined working surface with longitudinal and transverse T-slots for locating and clamping a vise or a work-holding fixture. The table is fed by means of a rack and a pinion, actuated through the hand-lever. Adjustable stops regulate the length of stroke. For convenient operation, a feed pinion is provided near each end of the table ways. The maximum table movement effected through either pinion is 16 inches.

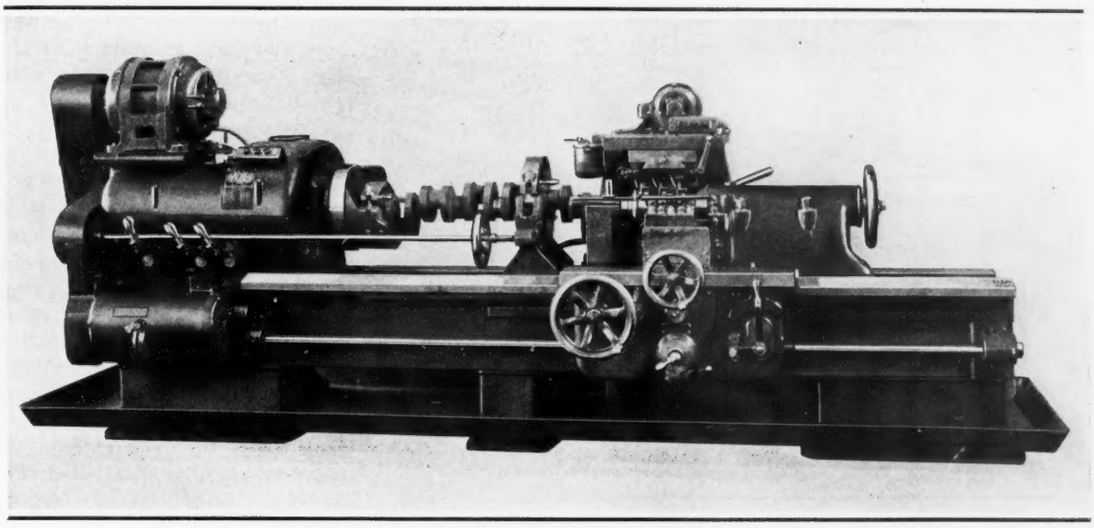
The grinding spindle is mounted in ball bearings in a sleeve clamped to one end of a swinging arm. The spindle is driven through V-belts by a five-horsepower motor mounted on the rear end of the arm. Three pulleys are regularly furnished to provide spindle speeds of 3900, 5800, and 8000 revolutions per minute, but pulleys can be supplied



Taylor-Winfield Roll Seam-welder Designed for Use in Building Aluminum Trains



Special Machine for Oil-groove Grinding, Cutting off, and Other Operations



Wickes Crankshaft Lathe with Inverted Cross-slide for Rear Tools, in Addition to Front Cross-slide

for other speeds. The driving motor is adjustable to compensate for differences in the center distance between the pulleys.

The swinging arm oscillates on Timken roller bearings and is counterbalanced to lift the grinding wheel from the work automatically. A foot-treadle or a hand-lever may be used for advancing the grinding wheel to the cutting position. An adjustable screw stop regulates the depth of cut, and an adjustable stop is also provided to regulate the amount of vertical movement of the grinding wheel. The grinding wheel can be positioned parallel to the travel of the table, at right angles to the travel, or at any intermediate angle. Scales and pointers indicate the angle.

Wickes Semi-Automatic Lathe

A semi-automatic lathe equipped for machining the flywheel end of airplane type crankshafts, has been developed by Wickes Bros., Saginaw, Mich. A feature of this machine, which is shown in the accompanying illustration, is an inverted cross-slide for carrying the cutting tools at the rear. With this construction, the upward cutting pressure on the rear tools is taken direct by the inverted cross-slide and by the heavy housing to which the cross-slide is attached. Unusually heavy cuts can be taken by the rear tools without chattering. Downward pressure on the front cutting tools is taken by the front cross-slide and the bed in the usual manner.

The crankshaft handled by the machine shown has an over-all length of 53.3 inches. The operation consists of finish-turning, finish-facing, and chamfering the flywheel flange, and finish-turning the same end of the crankshaft proper. The crankshaft has a Brinell hardness of between 319 and 385. The production averages three crankshafts an hour.

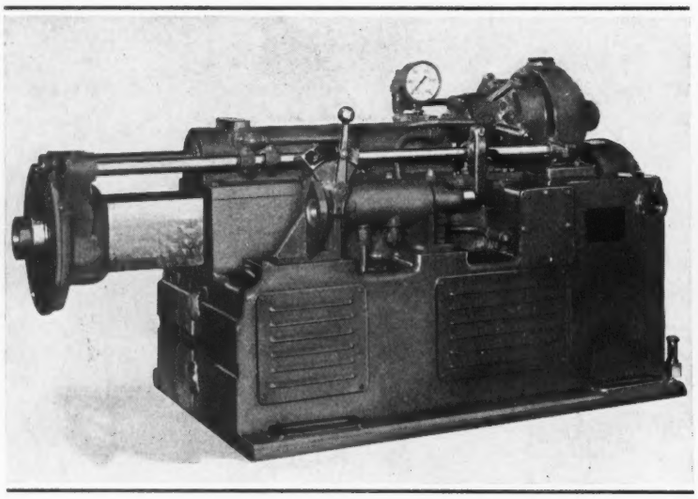
The crankshaft is mounted on extensible centers, and in addition, is supported on a center main bearing in a roller type of steadyrest. Longitudinal location is obtained by applying an indicator against the outer face of the flywheel flange. This indicator is conveniently mounted on the machine between the front cross-slide and the steadyrest.

The lathe is provided with a twelve-speed headstock and a quick-change gear-box. A 10-horsepower motor drives the equipment through multiple V-belts. Automatic stops are supplied for both the front and rear tools.

Six New Grades of Carboloy

The Carboloy Company, Inc., 2481 E. Grand Blvd., Detroit, Mich., has placed on the market six new grades of Carboloy cemented carbide to supplement the six grades previously made. The new grades have been developed primarily to obtain improved performance in special applications. Among these applications are included the rough- and finish-boring, finish-turning, and facing or steel brake-drums; single-point finish-boring of steel connecting-rods; reboring of automotive cylinders; and turning, facing, and boring of piston-rings.

The new grades are designated as 715, 831, 883, 905, 906, and 907. The company states that the twelve grades of Carboloy now available are adequate for all present machining applications within the existing range of cemented-carbide use. The manufacturer intends, however, to develop other special grades for applications where it may be indicated that improved results can be obtained.



Barnes Hydraulic Drill Unit with a Square Ram

Barnes Square-Ram Hydraulic Drill Unit

A hydraulic drill unit with a large square ram for supporting and guiding the tools has recently been developed by the W. F. & John Barnes Co., Rockford, Ill., for application to existing machines or for incorporation in manufacturers' own designs. This unit is intended for the class of work that does not require the heavy-duty hydraulic drill heads manufactured by the same concern.

The new square-ram unit is of compact design and is completely self-contained. It is intended for drilling, boring, reaming, milling, and similar operations. Enclosed in the base is a standard electric motor for driving the unit. The square ram is machined to a true fit through a long bearing. A spindle extends the full length of the ram for driving single cutting tools that may be inserted in the spindle nose, as well as for transmitting power to multiple-spindle heads that may be attached to the flange on the front end of the ram. The spindle is driven by the motor through pick-off gears. Anti-friction bearings are supplied for all shafts, including ball bearings for the spindle.

This square-ram unit can be operated at any angle, and any number of units can be run in combination, with centralized or independent controls. As on the heavy-duty units made by the company, the hydraulic feed cycle on the square-ram unit provides a rapid approach of the tools to the work at a fixed rate; any desired feed rate between zero and the maximum for which the cycle is intended; an accurately controlled dwell, if required; a rapid return of the tools to the starting position; and an automatic stop or a repeat of the cycle.

An adjustable-volume pump supplies oil at high pressure for feeding the tools to the work, while a constant-volume pump supplies oil in large quantities for rapid traverses. There is a control valve for instantly changing the movement of the cutting tools from the feed rate to the rapid traverse or vice versa. The hydraulic circuit is so designed as to eliminate air. The base of the unit measures 21 1/2 by 34 inches. The ram has a 12-inch stroke.

An application of a square-ram unit to a special machine built by the W. F. & John Barnes Co. for operations on an automobile motor and flywheel housing assembly was shown in May MACHINERY, page 559.

Elwell-Parker Gasoline-Driven Lift Truck

Electric trucks have been built by the Elwell-Parker Electric Co., Cleveland, Ohio, for more than twenty-five years and combination gasoline-electric trucks have been produced more recently. To this line the company has now added the three-ton straight gasoline-operated lift truck here illustrated, so that the complete line now makes available trucks with the kind of power best qualified for the work to be done.

In designing the gasoline-

Elwell-Parker Three-ton Lift Truck Driven by Gasoline Engine

driven unit, it was the aim to follow up-to-date automotive practice. For example, the controls are grouped within easy reach of the operator's right hand. These controls include the choke, electric starting button, throttle, and shift lever. Dials and indicators are located on an instrument board directly in front of the operator. A button at the end of the driver's handgrip operates a horn. With this arrangement, the operator can keep his left hand continually on the steering wheel. Steering is readily accomplished with one hand.

The throttle control is located beneath the grip by which the operator steadies himself when traveling at high speed. There are two forward speeds and two reverse speeds. A single pedal controls both the brakes and the clutch. The brakes are set the instant the operator lifts his foot, and further protection is afforded by a transmission lock. The hoisting mechanism is of the hydraulic type. Extra clearance has been provided beneath the platform by locating the hoisting cylinder high in the truck.

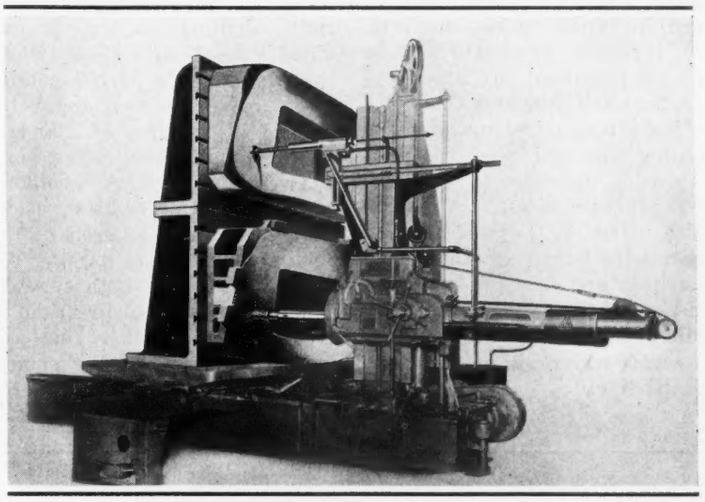
New Grades of "Spedia" Wheels

"Spedia" wheels, in an extra fine grade for polishing Widia and other cemented carbides, are being introduced on the market by Thomas Prosser & Son, 15 Gold St., New York City. "Spedia" wheels are diamond-impregnated molded-Bakelite lapping wheels. They were first described in November, 1933, MACHINERY, page 180, at the time that they were introduced on the American market.

The same company is also announcing a taper cup-wheel in the regular lapping grade, which is 3 inches in diameter and is intended for use on cutter grinders. These two additions to the "Spedia" line are said to enable cemented-carbide tools to be reground properly, thus providing a longer life between grinds and a better finish on the work.

Work Duplicator for Boring and Milling Machines

Irregular shaped work, such as power-press dies, drop-forge dies, and molds, can be conveniently machined from models or templets on standard boring or milling machines through the use of hydraulically operated "duplicators" made by the Clearing Machine Corporation, 6499 W. 65th St., Chicago, Ill. The illustration shows a duplicator applied to a large horizontal boring, drilling, and milling machine. On this machine, the plaster or wood model to be duplicated is mounted on a vertical platen directly above the work.



Duplicator Applied to a Boring, Drilling, and Milling Machine for Finishing a Large Die to the Shape of a Model

A tracer on the duplicator rides on the model surface that is to be reproduced on the work, and as this tracer moves up and down the "hills and valleys" of the model, it causes corresponding in and out movements of the cutter-spindle. The movement of the tracer bar as the tracer head moves up an incline is not strictly axial, but rather a combined angular deflection and retracting horizontal movement. The deflection opens a control valve on the tracer arm, thus admitting oil under pressure to a cylinder on the right-hand end of the spindle head, which causes a backward movement of the cutter-spindle through pressure exerted on a piston attached to the spindle.

When the tracer head moves down an incline, an opposite movement of the spindle is effected by the tracer head and the control valve. In this way, the in and out movements of the cutting tool are completely under the control of the tracer head as the work and the model are carried horizontally by the table past the tracer and cutting tool. Rubber tips are used on the tracer head for roughing cuts, and aluminum tips for finishing cuts.

The duplicator equipment includes a tank, motor, pump, manifold, and piping, in addition to the tracer mechanism, control valve, and cylinder. None of this equipment need be removed from the machine when ordinary work is to be handled; it is merely necessary to stop the hydraulic pump. Duplicators can be supplied for work of any dimensions and to fit any standard make of vertical or horizontal boring mill.

Air-Driven Rubbing, Polishing, and Sanding Machines

Portable rubbing, polishing, and sanding machines, air-driven at speeds of from 1200 to 1600 strokes a minute, are manufactured by the Sundstrand Machine Tool Co., Rockford, Ill., and solely distributed by the Paasche Airbrush Co., 1909-27 Diversey Parkway, Chicago, Ill. The illustration shows one of these machines smoothing a large flat surface. The machines are built in large and small sizes with two pads, and in a small size with a single pad. Both sizes can be used for finishing flat surfaces, and the small sizes can also be applied to curved surfaces.

A flush attachment is furnished with the large-sized machine for feeding water between the pads as needed, in order to keep the work surface moist. A button valve permits the operator to control the supply of water. All machines are equipped with the unit seen along the right-hand wall in the illustration, which separates water, oil, or rust from the air line.

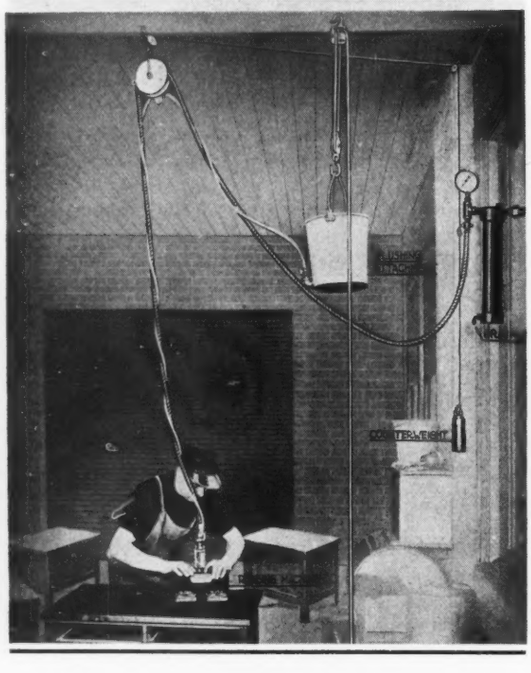
The Paasche Airbrush Co. has also recently brought out a line of convertible stripers and flow-guns intended primarily for striping and otherwise decorating metal specialties, toys, and other objects. Lacquer, paint, enamel, etc., can be used in these guns. The flow of the liquid is controlled by a sleeve that regulates the stroke of a needle.

Carlton Small-Sized Radial Drilling Machine

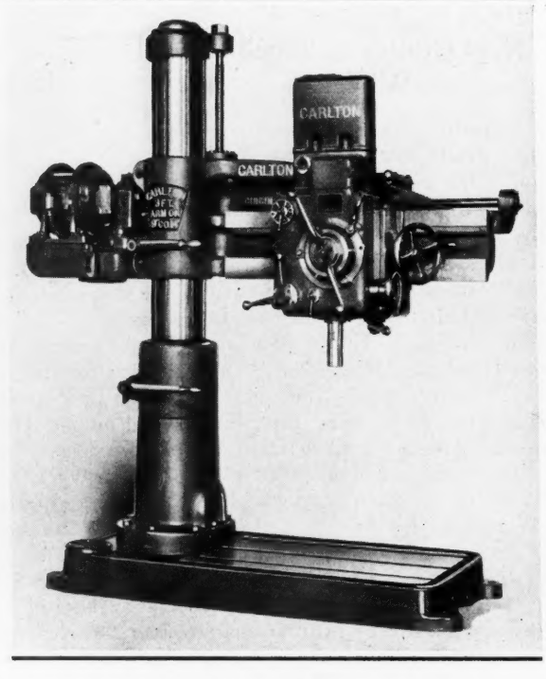
A radial drilling machine with a 3-foot arm mounted on a 9-inch column has been added to the line of machines built by the Carlton Machine Tool Co., Cincinnati, Ohio. As on the larger machines built by this concern, the new radial drilling machine is provided with a low-hung drive to the spindle, the drive coming down under the arm and being applied at the largest diameter of the spindle, close to the work.

Twelve speeds are available, ranging from 80 to 2000 revolutions per minute or from 120 to 3000 revolutions per minute. The spindle is driven both forward and in the reverse direction by multiple-disk clutches that run in oil. Reversal of the spindle can be accomplished at any speed almost instantaneously. There are six feed changes covering a range of from 0.006 to 0.025 inch per spindle revolution. Automatic stops are provided for the spindle at the maximum points of its travel up and down. A dial is set to stop the spindle automatically at any depth.

The arm is operated up and down on the column by a revolving nut which is actuated from the main driving unit at the back of the arm. The arm is also equipped with automatic stops for its maximum travel up and down. A single lever is moved both to raise and lower the arm, and when this lever is in its neutral position, it locks the arm around the column. The column is mounted on tapered roller



Using an Air-driven Rubbing Machine on a Large Flat Surface



Small-sized Radial Drilling Machine Added to the Line of the Carlton Machine Tool Co.

bearings, so that the arm can be swung with ease.

The machine is designed, assembled, and tested in units, each unit being provided with a sight oil level. A pump in the head delivers oil to all shafts, gears, and bearings. It is necessary to replenish the oil only once every six months.

Cleveland Profiling and Die-Sinking Attachment

Profiling and die-sinking operations can be performed on any universal milling machine by the use of an attachment developed by the Kremer-Cummins Machine Co., 6011 Lexington Ave., Cleveland, Ohio. This attachment is applied to the over-arm of milling machines in the same manner as an arbor support. It can be easily removed from the machine when ordinary work is to be performed.

From the illustration it will be seen that two arms on the attachment extend over the table from a hinged shaft at the front of the machine. This shaft is supported by tapered roller bearings. One of the extending arms carries a cutting tool and the other a follower or stylus. The arms are rigidly connected, so that every movement of the follower is accurately reproduced by the cutter.

In operation, the table of the milling machine is elevated to a height where the follower and cutting tool are vertical. The arms that hold them are then horizontal, and the point at which work is being done is in a horizontal line with the hinged shaft. As the table moves back and forth, the follower rides over the pattern, and the cutter accurately reproduces the contour of the pattern on the work.

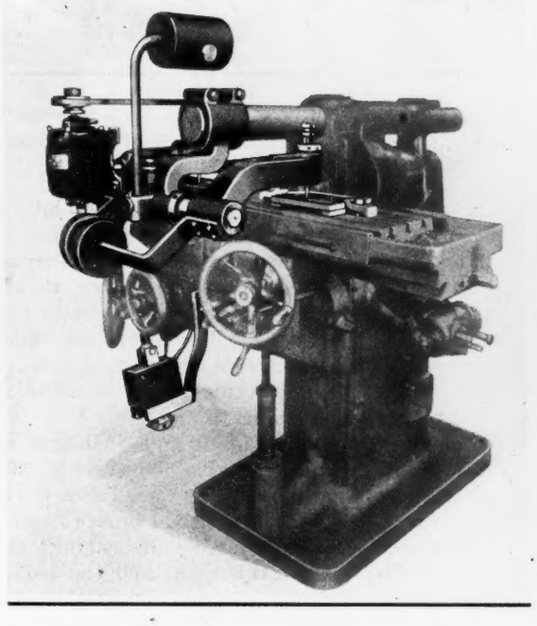
The motor is provided with a double grooved pulley which is interchangeable with a pulley on the cutter-spindle, making available eight speeds from 800 to 5000 revolutions per minute. Automatic stops can be adjusted to suit the work being done. These stops energize an electric magnet to feed the work laterally at the same time that the table movement is reversed.

Multiple-Tool Saddle for South Bend Lathes

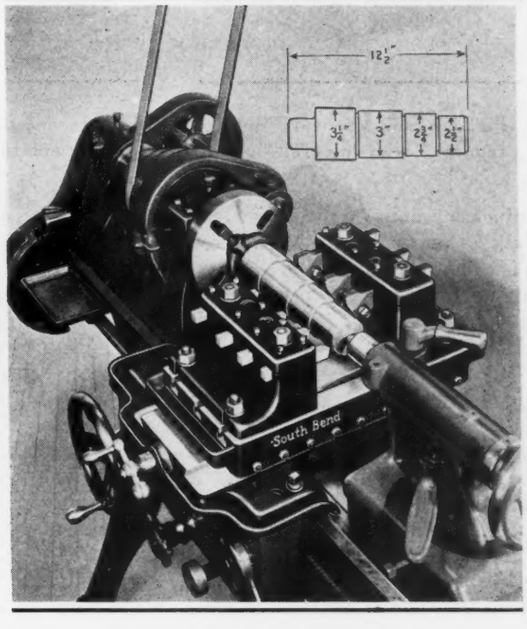
A multiple-tool base saddle that facilitates production operations has recently been developed by the South Bend Lathe Works, 731 E. Madison St., South Bend, Ind., for application to the regular 13-, 16-, and 18-inch screw-cutting precision lathes built by the concern. This saddle is designed primarily to accommodate special tool-holding blocks at both the front and rear for obtaining multiple tool set-ups.

In the illustration, one of these saddles is shown set up for a turning and necking job. The front tool-holding block is provided with four tools for turning to four diameters. The rear tool-block holds three parting tools for taking shouldering and necking cuts. Although seven operations are performed, the lathe is operated the same as an ordinary engine lathe.

The saddle is connected to the automatic longitudinal feed mechanism of the machine and is pro-



Profiling and Die-sinking Attachment for Universal Milling Machines



South Bend Engine Lathe Equipped with Multiple-tool Base Saddle for a Production Job

vided with an automatic cross-feed. Micrometer cross-feed stops for the front and back tools enable accurate work to be turned out on a high production basis. There is also a stop for the automatic longitudinal feed.

The same saddle can be used for a variety of multiple tool set-ups on motor shafts, pump shafts, and other parts of several diameters. Also, the slotted table of the saddle can be used as a clamping table in milling, boring, reaming, drilling, keyway-cutting, and other work.

Falk Vertical "Motoreducers"

Vertical "Motoreducers" in a complete range of sizes have been added to the line of horizontal "Motoreducers" and horizontal right-angle and vertical speed reducers manufactured by the Falk Corporation, Milwaukee, Wis. The vertical "Motoreducers" are made in three types to meet requirements, and in sizes from 3/4 to 75 horsepower.

Fig. 1. Falk Vertical "Motoreducer" with Integral Motor

Fig. 2. Vertical "Motoreducer" with Standard Horizontal Motor

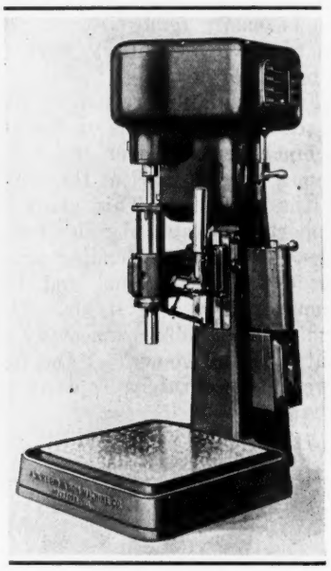
In the IX type, shown in Fig. 1, the motor is integral with the reducing mechanism, the motor end-bell being removed and the stator close-coupled to the gear-case by means of an adapter. This gives a compact design. The ZX type, illustrated in Fig. 2, is designed to be driven by any standard horizontal ball-bearing motor. A resilient connection between the motor and the gearing is afforded by means of a Falk-Bibby coupling. Both the IX and ZX units are made with double and triple reductions which give ratios from 9.7 to 1 up to 288 to 1.

The LX type unit is made with a single reduction only. Ratios from 1.5 to 1 up to 9 to 1 are available in this type.

Helical gears and ball or roller bearings are used in these motor-driven gear reducing units. In the double and triple reduction types, lubricant is brought to the meshing point of the gears and to the bearings by a circulating system which includes a special pump and spray piping. The lower bearing is lubricated by light grease, which is replenished through an Alemite fitting. In the single reduction type, oil is supplied to the gears and bearings by a different method.

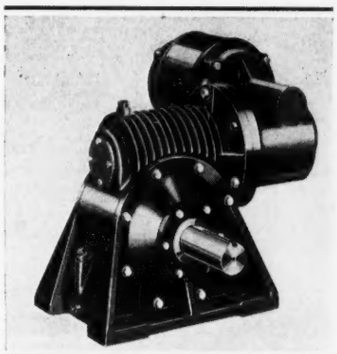
Redin Sensitive Bench Drilling Machine

The rolling-wedge transmission which is the particular feature of a sensitive drilling machine made by the A. W. Redin & Son Machine Co., 1846 Eighteenth Ave., Rockford, Ill. (described in January MACHINERY, page 312) is also incorporated in the machine here illustrated, which was designed by the same concern to meet United States Navy specifications. This transmission provides eight speeds, ranging in geometrical progression from 395 to 3700 revolutions per minute, without the use of belts or gears. The drive is transmitted from the motor to the spindle by means of a motor pulley, cone pulley and non-metallic idler. Speeds are changed through the movement of convenient quick-shift levers.

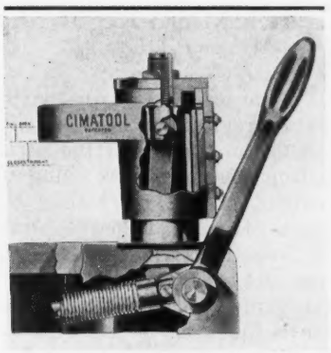


Redin Bench Drilling Machine with Rolling-wedge Transmission

Holes up to 5/8 inch can be drilled in cast iron with this equipment. The base has a working surface of 240 square inches. Fully enclosed ball bearings are used throughout, and the transmission is also completely enclosed. The built-in motor is of 3/4 horsepower and has two operating speeds.



Janette Speed Reducer with Double Worm-gear Reduction



Toggle and Clamping Mechanism of the Cimatool-Paulins Jig

Janette Double-Reduction Worm-Gear Speed Reducers

A series of motorized double worm-gear reduction units of the construction here illustrated has been added to the line of such equipment made by the Janette Mfg. Co., 556-558 W. Monroe St., Chicago, Ill. The units of the new line are equipped with motors ranging in capacity up to 1 horsepower.

The motor of each unit is connected to a train of two worm-gear reductions. Standard ratios range from 96 to 1 up to as high as 8100 to 1. Motors can be supplied in direct-current and single-phase or polyphase alternating-current types. The motor is of ball-bearing design, and all gear-shafts run in tapered roller bearings. Polished steel worms and bronze gears are used.

Cimatool-Paulins Drill Jig

A number of improvements have been made in the patented Paulins jig to increase its effectiveness and flexibility since the Paulins Tool & Engineering Co., Detroit, Mich., was acquired by the City Machine & Tool Co., Dayton, Ohio. The changes include simplified bushing plates and other improved details for both the single- and double-post models equipped with positive-lock or spring-type mechanisms.

The previous linkage and locking arrangements have been retained in the newer designs to provide the clamping power and operating speed of the previous jigs. In the spring-type mechanism, two springs together exert a pressure of from 90 to 105 pounds. As will be seen from the illustration, all parts of the toggle and clamping mechanism are fully enclosed to protect them from chips and dirt. A large-diameter barrel gives sturdiness to the assembly.

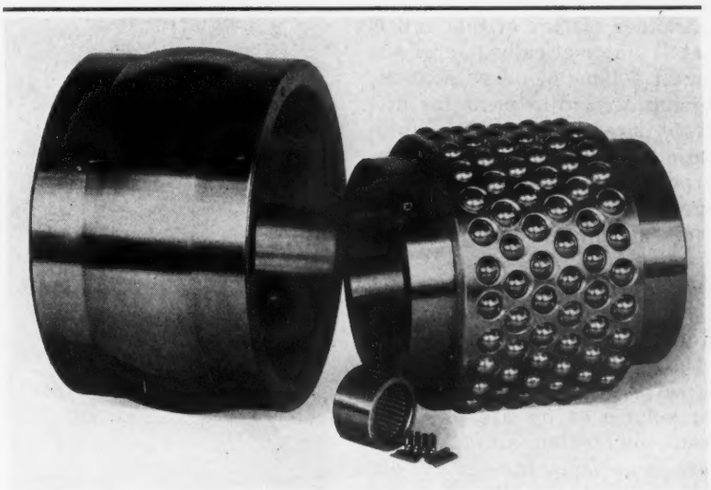
In the illustration, the position of the operating lever is practically on dead center. Moving this lever to the right will increase the opening of the jig through the linkage, the two springs aiding this movement. When the operating lever is moved to the left of dead center, the pressure of the springs is again brought into play to aid in closing the jig and holding it closed.

One of the important advantages of these drill jigs is that changes in the design of the part being manufactured need not make the jig obsolete. The main body would probably remain serviceable, and if a new bushing plate were required, it could be furnished from stock.

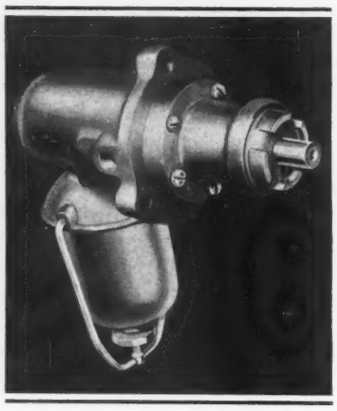
Bantam Reciprocating Ball Bearing

The ball bearing here illustrated is designed for use on shafts that reciprocate as well as rotate. This bearing has recently been developed by the Bantam Ball Bearing Co., 3400 W. Sample St., South Bend, Ind. It is particularly intended for such applications as the inking rollers of printing presses and sheet polishing machinery used in steel mills.

The balls are assembled in the cage in a helical path so as to prevent the wearing of grooves in the shaft in the event that the shaft is rotated for long periods at a time. The bearing is self-aligning.



Bantam Bearing Designed for Shafts that Reciprocate as well as Rotate



Automatic Fuel Unit for Industrial and Domestic Oil Burners

Sundstrand Automatic Fuel Unit

An automatic fuel unit for application to pressure atomizing oil burners has been added to the line of rotary pumps manufactured by the Sundstrand Machine Tool Co., Rockford, Ill. This unit is intended for use on heat-treating furnaces, ovens, etc., in industrial plants, as well as for domestic installations. It consists of a variable displacement pump and a strainer. The pump automatically takes care of the work usually done by valves, thus eliminating all valve mechanism in the operation of a pressure-type oil burner.

Another feature of this unit is that it automatically pumps the correct volume of oil without requiring any adjustment for different sized nozzles. An automatic air relief or bleed is incorporated. Among the advantages claimed for this design are a quiet running pump, low power consumption, and compactness. The unit is unusually small and is made up of few parts, thus affording simplicity.

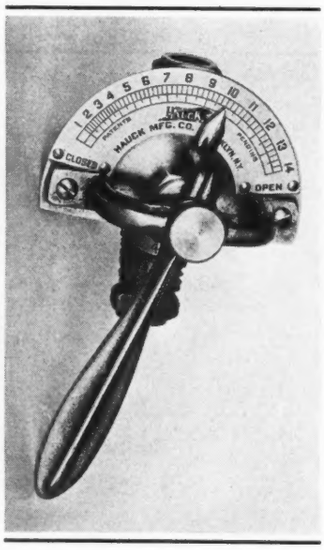
Only the fuel that is actually burned is pumped. Full pressure and volume of oil are provided when combustion starts, while there is an instantaneous cut-off of the oil to the nozzle when the furnace is stopped, so as to avoid the dripping of oil. A pressure adjustment is also provided.

Hauck Micro Regulating Valves

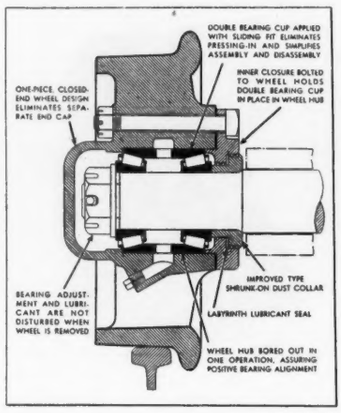
Valves designed to insure the minute regulation of oil delivered to the burners of industrial heating equipment, are being introduced on the market by the Hauck Mfg. Co., 126-134 Tenth St., Brooklyn, N. Y., in the increment type illustrated and also in a vernier type. The increment type is operated by a lever connected to the valve stem. Any desired amount of opening or a full opening or closing of the valve can be immediately obtained. The vernier type is operated by turning a knurled knob. This type of valve provides for exceedingly close adjustments.

Both types of these Micro regulating valves are of a design in which the area of the orifice is increased or decreased by minute increments as the valve plug is turned relatively large amounts. Even with the smallest opening, sediment cannot clog the valve. The construction of the mechanism is such that the valve is said to actually increase in efficiency as the parts are worn in.

In addition to oil-burning applications, these valves can be used for controlling the flow of various liquids.



Micro Valve Designed for Close Regulation of Fluids


DOUBLE BEARING CUP APPLIED WITH SLIDING FIT ELIMINATES PRESSING-IN AND SIMPLIFIES ASSEMBLY AND DISASSEMBLY
INNER CLOSURE BOLTED TO WHEEL HOLDS DOUBLE BEARING CUP IN PLACE IN WHEEL HUB
ONE-PIECE, CLOSED-END WHEEL DESIGN ELIMINATES SEPARATE END CAP
IMPROVED TYPE SHRUNK-ON DUST COLLAR
LABYRINTH LUBRICANT SEAL
BEARING ADJUSTMENT AND LUBRICANT ARE NOT DISTURBED WHEN WHEEL IS REMOVED
WHEEL HUB BORED OUT IN ONE OPERATION, ASSURING POSITIVE BEARING ALIGNMENT

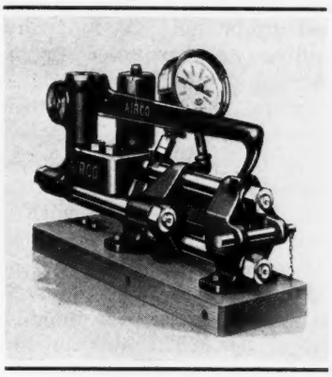
Timken Mine-car Bearing Mounting with Double-cup Bearing

Timken Roller-Bearing Mounting for Mine Cars

The use of a double-cup roller bearing in place of two single cups is one of the features of a bearing mounting for mine-car service which has recently been designed by the Timken Roller Bearing Co., Canton, Ohio. The shrunk-in-place steel dust collar of Timken mine-car bearing mountings has been retained, but it has been so modified that it provides a labyrinth seal in conjunction with the inner closure. This eliminates the possibility of losing lubricant and prevents the entrance of grit and water.

Outer sealing is insured by casting the end cap integral with the wheel, as shown in the illustration. To remove this new type of wheel, it is only necessary to loosen three bolts. The wheel hub is bored in a single operation, which insures correct bearing alignment and long bearing life. When wheel replacement is necessary or when it is desired to inspect the bearings, the wheel can be slipped off easily without disturbing the bearing adjustment. The bearing remains on the axle as a complete unit, the wheel hub being machined for a slip fit over the bearing cup. Wheels can be changed on the track within fifteen minutes.

Closed-end wheel, stub and extended-axle types of the mounting are obtainable.



Portable Machine for Making Tensile and Bend Tests on Welds

Airco Portable Weld-Testing Machine

A portable tensile and bend testing machine that can be carried right to the welding job for testing welded specimens has been designed by the Air Reduction Sales Co., Lincoln Bldg., 60 E. 42nd St., New York City. This machine consists essentially of an oil-pump, a hydraulically actuated piston or ram, two heads—one fixed and one movable—for gripping the test specimen, and four symmetrically located steel shafts. Two of these shafts transmit the piston motion and load to the movable head. The other two shafts maintain the alignment of the two heads and prevent the introduction of bending stresses in the tensile test specimen.

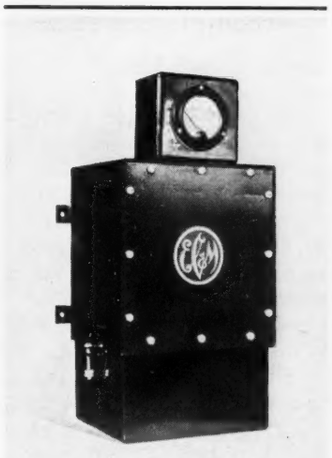
The length of the lever attached to the pump and the ratio between the area of the pump plunger and the hydraulic ram are such that the downward force on the pump lever is magnified 400 times in the load applied to the test specimen. This force magnification, together with the large piston displacement of the oil-pump, enables specimens to be tested rapidly and with minimum effort. The load applied to the test specimen is indicated by a 6-inch pressure gage.

After a specimen has been set up, a few strokes of the operating lever will apply a direct load up to 40,000 pounds per square inch on specimens from 9 1/2 to 10 inches long, up to 1/2 inch thick, and up to 1 1/2 inches wide. By using specimens of smaller cross-sectional areas than the maximum mentioned, loads equivalent to over 150,000 pounds per square inch can be applied to the specimens.

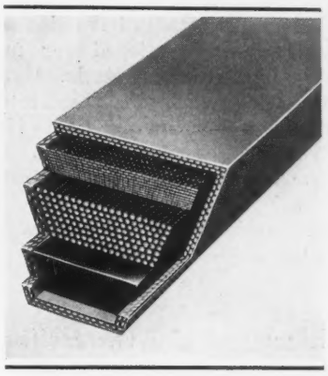
For bend tests the machine is provided with an anvil that fits into the movable head. This anvil bends the specimen against a pair of supports 3 inches apart, cast integral with the body of the machine. The machine, with its case, weighs slightly over 200 pounds.

EC&M Weather-Proof and Dust-Tight Motor Starters

A Type ZO across-the-line oil-immersed motor starter that is weather-proof and dust-tight has been added to the line of the Electric Controller & Mfg. Co., E. 79th St. and Woodland Ave., Cleveland, Ohio, for motors up to 15 horsepower, 220 volt; and 30 horsepower, 440 or 550 volt. These starters are enclosed in a case that is "Bonderized" and then black enameled. When desired, a self-contained ammeter enclosed in a dust-tight case can be mounted as illustrated. These motor starters are arranged for remote control push-button automatic operation.



Weather-proof Motor Starter with Self-contained Ammeter



Goodrich Multi-V Belt of a Three-layer Balanced Design

Goodrich Improved Multi-V Belts

Multiple V-belts manufactured by the B. F. Goodrich Rubber Co., Akron, Ohio, are now made in three layers, as illustrated, with a view to preserving proper balance. The three layers are balanced to resist stretch and to compensate for wear. These multi-V belts are compounded to reduce internal heat.

Electrodes for Welding High-Carbon and High-Strength Steels

A heavy coated electrode known as "Murex Special A" is being placed on the market by the Metal & Thermit Corporation, 120 Broadway, New York City, for arc-welding steels containing more than 0.20 per cent carbon. This electrode hinders the migration of carbon from the parent metal to the deposited metal. It is claimed that sound, dense, X-ray clean welds having excellent penetration can be made in high-carbon steels with ease.

The deposit contains a small quantity of nickel. It has unusually good physical properties and is stress-relieved. Weld-metal specimens invariably show clean, full-cupped fractures in tests. The tensile strength of deposits made with this electrode is 73,000 pounds per square inch and the yield point is 59,000 pounds per square inch.

Murex electrodes have also recently been developed for use with high-strength steels. With these electrodes, it is possible to obtain welds having tensile strengths of from 85,000 to 100,000 pounds per square inch. Nickel or molybdenum, or a combination of these elements, is included in the deposited metal.

Electrical Converters for Small Machine Tools

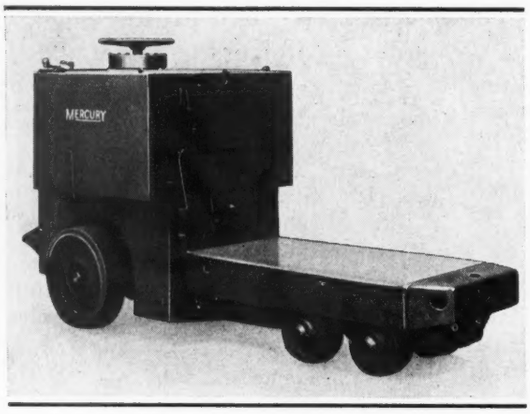
Inverted converters built from standard direct-current motor and generator parts for use with small machine tools, radio equipment, etc., when only direct current is available have recently been developed by the General Electric Co., Schenectady, N. Y. These converters are made in sizes from 1/2 to 20 kilovolt-amperes. They are available for changing 115- or 230-volt direct current to 110- or 220-volt alternating current. The converters are of inexpensive design and are readily portable.

Mercury Heavy-Duty Low-Lift Truck

A heavy-duty low-lift truck of five tons capacity has recently been added to the line of lift trucks, tractors, trailers, and other material-handling equipment made by the Mercury Mfg. Co., 4118 S. Halsted St., Chicago, Ill. This Model A-1010 truck has a hydraulic lifting system, magnetic contactor control, double-reduction bevel- and spur-gear driven axle, semi-elliptic spring suspension, brakes in the wheels, and positive overload protection. A four-wheel trailing axle, mounted in ball bearings, is another feature. All six wheels of the truck are steering wheels.

The hydraulic system provides a smooth easily controlled lifting and lowering action with a definite cushioning of the load and truck mechanism in all positions. This feature is particularly important in handling heavy loads. The overload protection consists of a simple relief valve which prevents picking up more than a capacity load.

Greatly reduced maintenance costs are said to result from the magnetic contactor control that is provided. The main power contacts have fingers of large area and the magnetic action prevents excessive arcing or burning of the fingers. It is impossible for the operator to hold the power contacts in an arcing position. The magnetic contactor control provides automatic acceleration, thus preventing wear and tear on the truck and its drive as a result of careless handling.



Mercury Low-lift Truck in which Acceleration is Automatically Controlled

Synthetic Rubber Tire an Accomplished Fact

Tires made entirely of a synthetic product known as Du Prene developed by the E. I. du Pont de Nemours & Co., have been made by the Dayton Rubber Mfg. Co., Dayton, Ohio, according to an announcement made by that company. These tires have been subjected to the most exacting tests in direct comparison with tires made of natural rubber, and have proved to be equally tough and durable. They are made by the same machinery that is used to produce natural rubber tires. The material, Du Prene, from which they are made, is a product composed of ingredients that are found in abundance in the United States. Among these ingredients are coal, limestone and salt.

The new synthetic rubber is more resistant than natural rubber to the swelling action of gasoline, kerosene and other solvents, and more resistant to the deterioration of air and to the action of chemicals that are destructive to natural rubber. It is resistant to oil and vulcanizes by the use of heat alone. The new tires have been tried out under severe road conditions in direct comparison with tires of natural rubber. No difference in the wear of the two products has been disclosed.

The Dayton Rubber Mfg. Co. has just completed a specially designed new plant for the production of synthetic rubber products.

The importance to the United States of this new development from the standpoint of national security and economy cannot be overestimated. As to how extensively synthetic rubber will be used in the near future depends largely on the price of natural rubber in the world's rubber market. At present it is likely that the use of synthetic rubber tires will be held in reserve, as long as foreign supplies of natural rubber remain undisturbed and the supply is adequate. But the fact that such a product is available, is likely to exercise an influence on the price of natural rubber.